Robin Industrial Engines®

SERVICE MANUAL

Models
EY15, EY20, EY28

1193S103

Robin®

ROBIN AMERICA, INC.
ROBIN TO WISCONSIN ROBIN
ENGINE MODEL CROSS REFERENCE LIST

ROBIN	WISCONSIN ROBIN
SIDE VALVE	
EY08	W1-080
EY15	W1-145
EY15V	W1-145V
EY20	W1-185
EY20V	W1-185V
EY23	W1-230
EY28	W1-280
EY35	W1-340
EY40	W1-390
EY45V	W1-450V
EY21	EY21W
EY44	EY44W
EY18-3	EY18-3W
EY25	EY25W
EY27	EY27W
OVERHEAD VALVE	
EH11	WO1-115
EH12	WO1-120
EH15	WO1-150
EH17	WO1-170
EH21	WO1-210
EH25	WO1-250
EH30	WO1-300
EH30V	WO1-300V
EH34	WO1-340
EH34V	WO1-340V
EH43V	WO1-430V
TWO CYCLE	
EC13V	WT1-125V
DIESEL	
DY23	WRD1-230
DY27	WRD1-270
DY30	WRD1-300
DY35	WRD1-350
DY41	WRD1-410

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Model		EY15		EY20D	EY28	
		EY15D	EY15B		EY28D	EY28B
Type		Cir-Cooled, 4-Cycle, Vertical, Single Cylinder Gasoline Engine				
Bore x Stroke (in)		63 mm x 46 mm (2.48" x 1.81")		67 mm x 52 mm (2.63" x 2.05")	75 mm x 62 mm (2.95" x 2.44")	
Piston Displacement (cu. in)		143 cc (8.73 cu. in)		183 cc (11.17 cu. in)	273 cc (16.6 cu. in)	
Compression Ratio		6.3				
Continuous Rated Output (HP/rmp)		2.2/3,000 2.7/3,600	2.2/1,500 2.7/1,800	3/3,000 3.5/3,600	4.7/3,000 5.5/3,600	4.7/1,500 5.5/1,800
Max. Output (HP/rpm)		3.5/4000	3.5/2,000	5/4,000	7.5/4,000	7.5/2,000
Max. Torque (kg-m/rpm)		0.68/2,800	1.36/1,400	0.95/2,800	1.4/2,800	2.8/1,400
Rotation		Counter-clockwise as viewed from P.T.O. shaft side				
Cooling System		Forced Air Cooling				
Lubrication		Splashing Type				
Lubricant		Automobile Oil Class SC				
Carburetor		Horizontal Draft, Float Type				
Fuel		Automobile Gasoline				
Fuel Consumption Ratio (gr/HP-h)		280 at continus rated output operation			290 at continuous rated output operation	
Fuel Feed		Gravity Type				
Fuel Tank Capacity		1.8 liters (0.73 U.S. gal.)		3.8 liters (1.00 U.S. gal.)	5.5 liters (1.45 U.S. gal.)	
Reduction Ratio		–	1/2	–	–	1/2
Speed Governor		Contrifugal Flyweight Type				
Ignition System		Flywheel Magneto Type (Solid State Ignition is available as option.)				
Spark Plug		NGK, B-6HS			NGK, BP-6HS	
Light Capacity (V-W)		12V, 15W (available, if required)				
Starting System		Recoil Starter (Rope Type is available, if required.)			Recoil Starter (Electric Starter is available as option)	
Dry Weight (lbs.)		13.2 kg (29 lbs.)	13.8 kg (30.3 lbs.)	15 kg (33 lbs.)	21 kg (46.3 lbs.)	21.5 kg (47.3 lbs.)
Dimensions	Length (in)	303 mm (11.9")	306 mm (12.1")	319 mm (12.5")	346 mm (13.6")	
	Width (in)	300 mm (11.8")	300 mm (11.8")	317 mm (12.4")	386 mm (15.2")	
	Height (in)	368 mm (14.5")	368 mm (14.5")	392 mm (15.4")	440 mm (17.3")	

2. PERFORMANCE

2-1 MAXIMUM OUTPUT

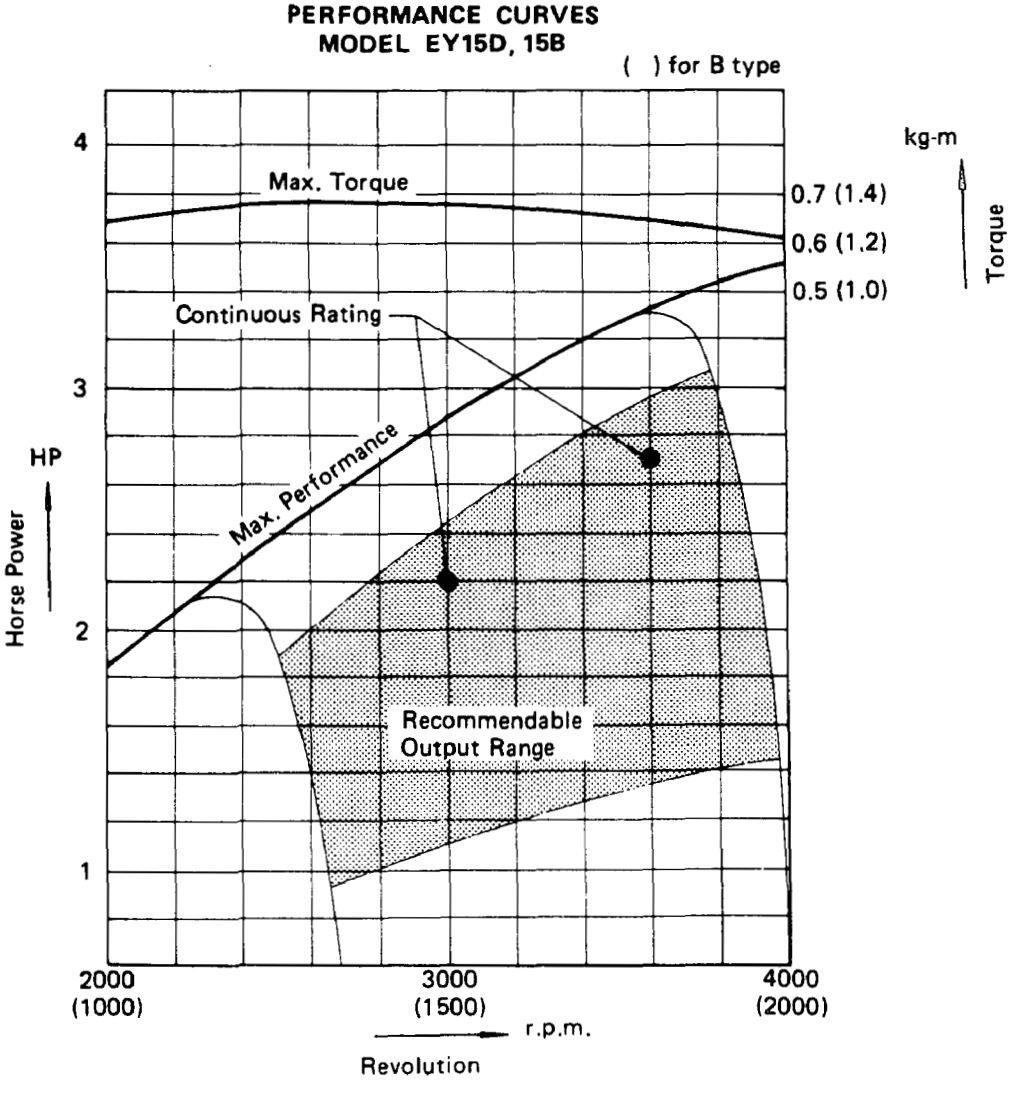
The maximum ouput of an engine is such standard power as developed by the engine, after its initial break in period with all the moving parts properly worn in, when operating with a fully open throttle valve. Therefore, a new engine may not develop the maximum output in the beginning because the moving parts are not in a properly worn-in condition.

2-2 CONTINUOUS RATED OUTPUT

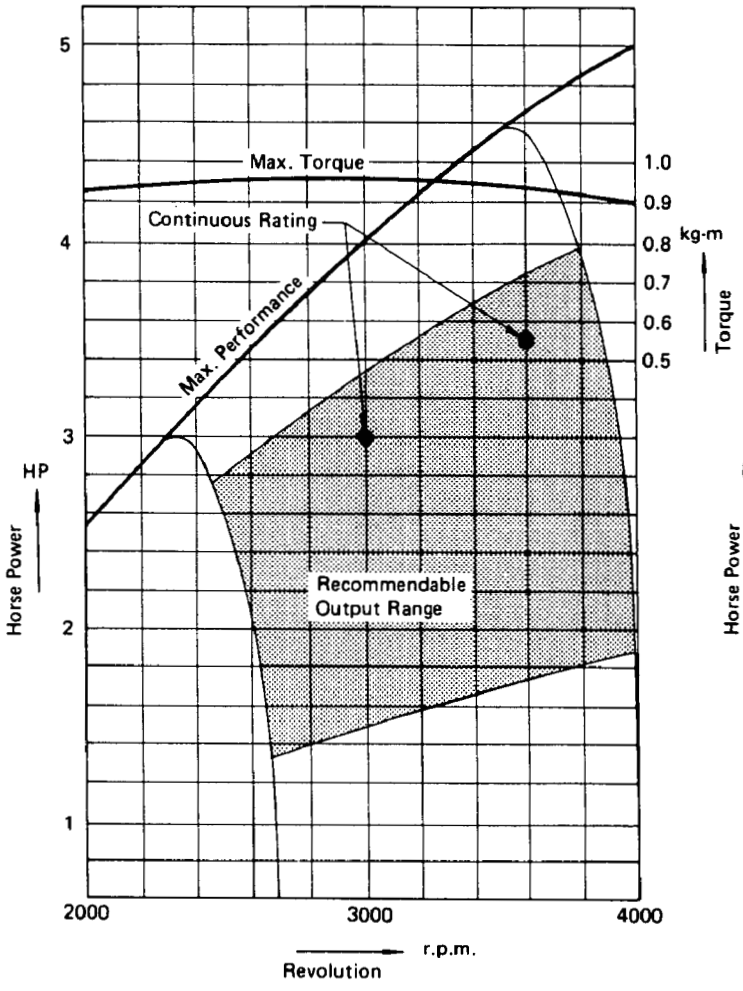
The continuous rated output of an engine is such power as developed by that engine when running continuously at an optimum speed, and most favorable from the viewpoint of engine life and fuel consumption ratio, with the governor in operation. It is suggested, therefore, that when designing a driving system for any mechanism, with this engine as prime mover, the continuous power requirement of that mechanism be kept below the continuous rated output specified.

2-3 MAXIMUM TORQUE

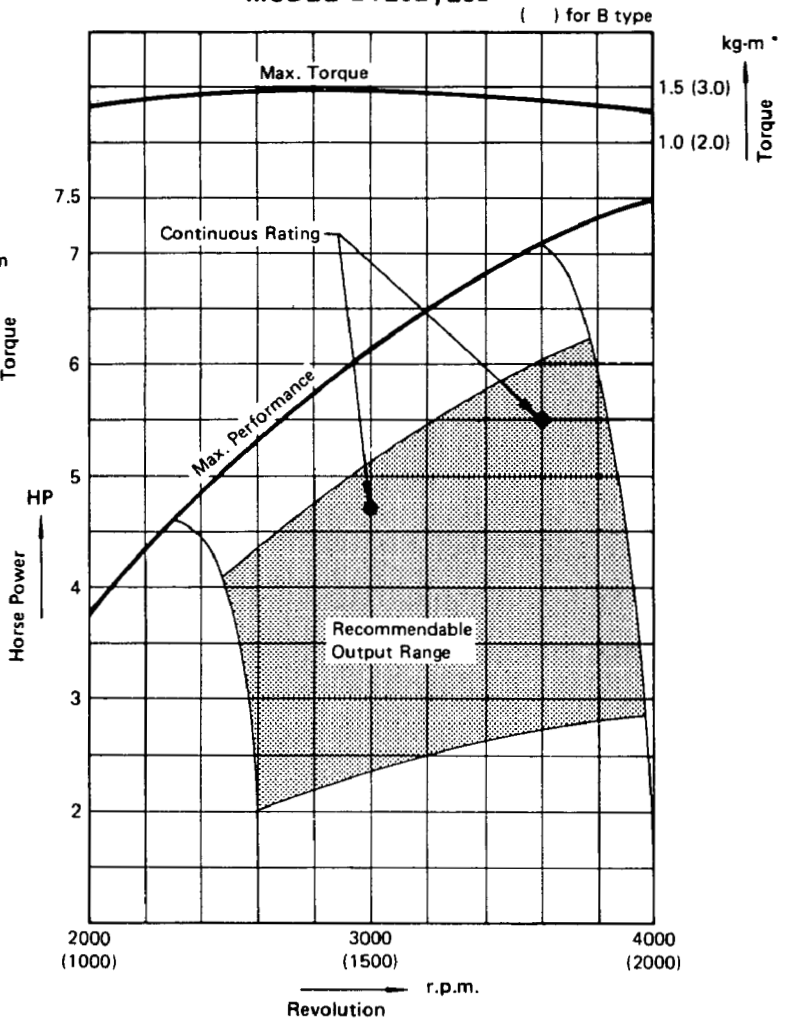
These mean the maximum torque of the output shaft and fuel consumption ratio at the maximum output of an engine.



PERFORMANCE CURVES
MODEL EY20D



PERFORMANCE CURVES
MODEL EY28D, 28B



3. FEATURES

1. Compact, lightweight, durable, powerful 4-cycle air-cooled engine embodying ingenious design techniques and skilful workmanship.
2. Simple construction, smart appearance, maximum easiness of start owing to automatic decompression device
3. Pointless Solid State ignition system is newly adopted for preventing poor igniting as option.
4. Reliable prime mover for variety of purposes with smooth speed control by a governor under varying load conditions.
5. Economical because fuel consumption is very low.
6. Great versatility in installation through a 360° belt extension possibility and a two-side oil fill and drain arrangement.

4. GENERAL DESCRIPTION of ENGINE CONSTRUCTION

4-1 CYLINDER, CRANKCASE

The cylinder and crankcase are single piece aluminum die casting. The cylinder liner, made of special cast iron, is built into the alminum casting. The intake and exhaust ports are located on one side of the cylinder, and are also inserted into the casting.

The crankcase is separable on the output shaft side, where the main bearing cover is attached to it.

(See Fig. 1.)

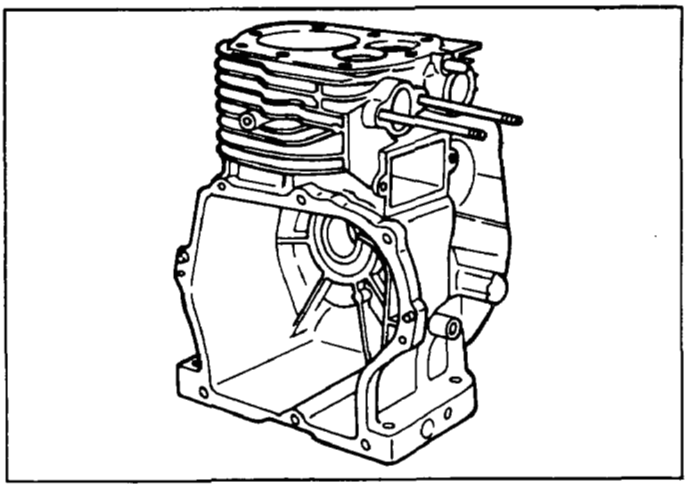


Fig. 1

4-2 MAIN BEARING COVER

The main bearing cover made of aluminum die casting is built onto the output shaft side of the crankcase so that the inside of the engine can readily be checked by simply removing the cover. It is provided with a flange and boss for directly mounting machines, such as generators and pumps.

Two oil gauges also serving as oil filler caps can be mounted. (See Fig. 2 and Fig. 3.)

The EY15B engine has 2 chain guides and a built-in shelter plate to prevent oil from being stirred by the governor gear (See Fig. 4.)

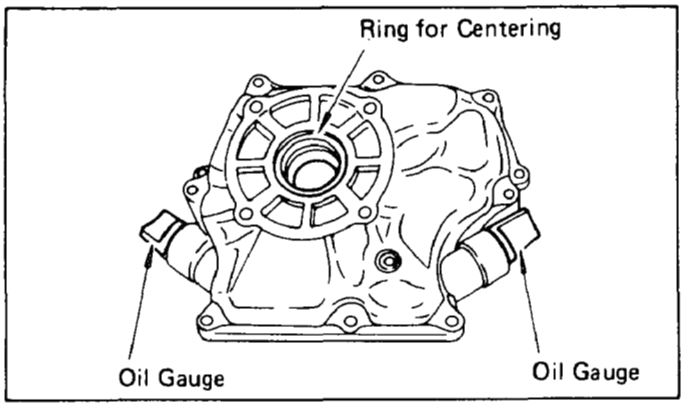


Fig. 2

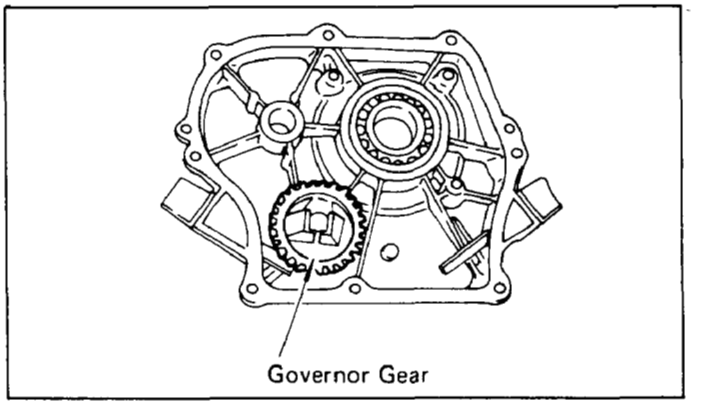


Fig. 3

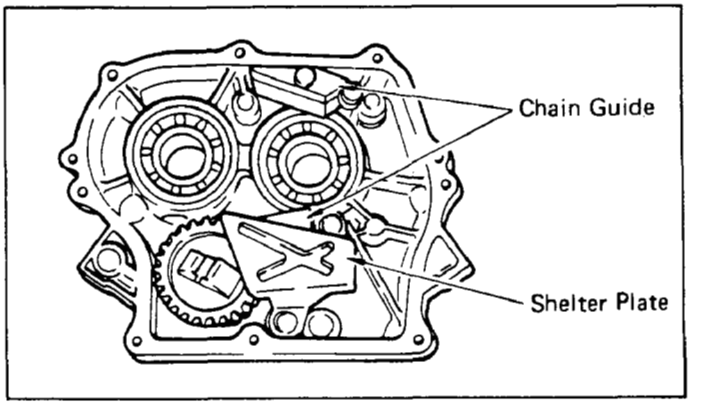


Fig. 4 (EY15B)

4-3 CRANKSHAFT

The crankshaft is forged of carbon steel, and the crankpin is induction-hardened. It has a crank gear pressured-fitted on the output end. (See Fig. 5.)

The EY15B type has a built-in drive sprocket. (See Fig. 6.)

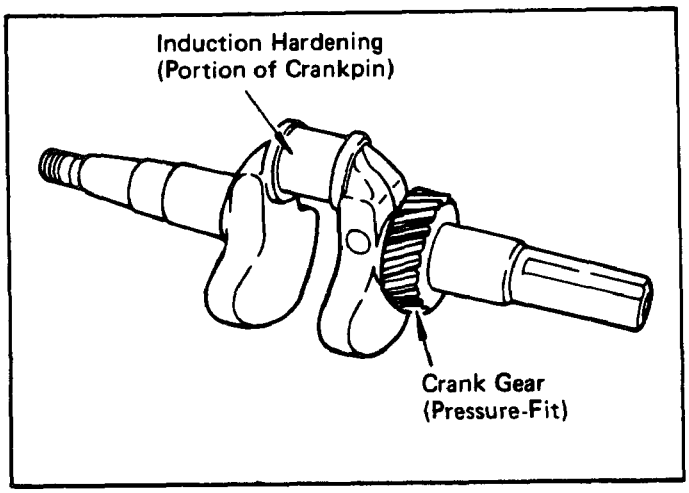


Fig. 5

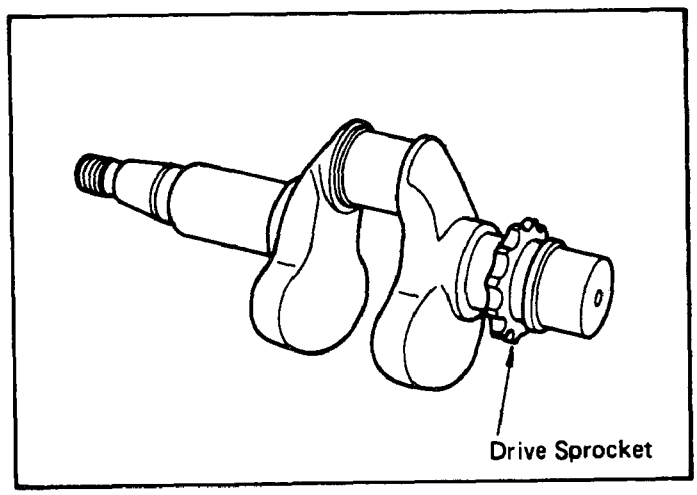


Fig. 6 (EY15B)

4-4 CONNECTING ROD, PISTON and PISTON RING

The connecting rod is forged of aluminum alloy, which itself serves as bearings at both the large and small ends. The large end has a built-in oil scraper for splashing the lubricating oil.

The piston is cast of aluminum alloy, and has grooves for receiving two compression rings and one oil ring.

(See Fig. 7.)

PISTON RINGS for EY28 ENGINE

This piston rings are made of special cast iron and the shape of the top ring is barrel face, that of second ring is taper under cut; and the oil ring has cutter expander. These rings are very much effective for decreasing engine oil consumption.

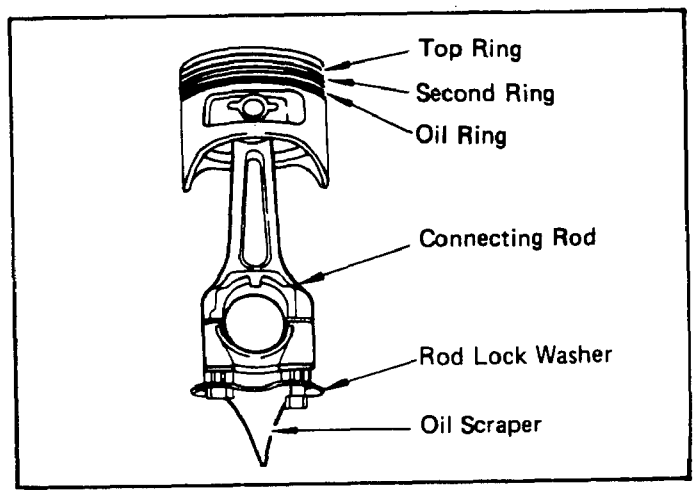


Fig. 7

4-5 CAMSHAFT

In the D type, the camshaft is integrally built with a cam gear of special cast iron, and has intake and exhaust cams. Also the camshaft has aluminum plain bearings attached to both ends. (No ball bearing is used.) (See Fig. 8.)

In the B type, the camshaft is made of carbon steel, and EY15B type has a pressured-fitted cam gear and a driven sproket. (See Fig. 9.) The camshaft functions also as an output shaft, and is driven by 1/2 rotation of the crankshaft, Ball bearings are used in the output shaft side.

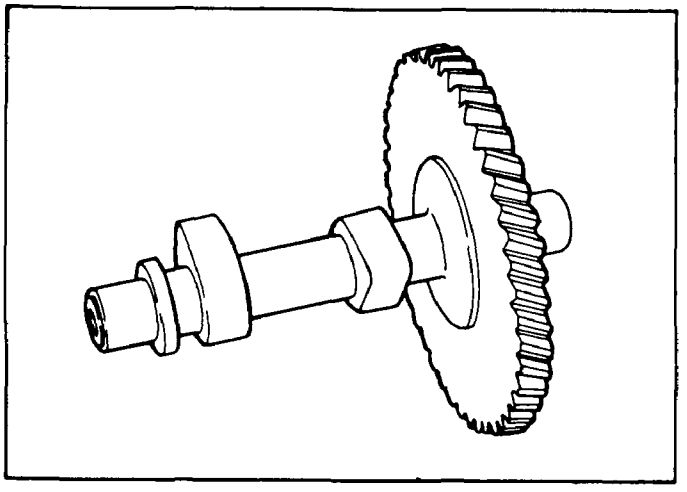


Fig. 8

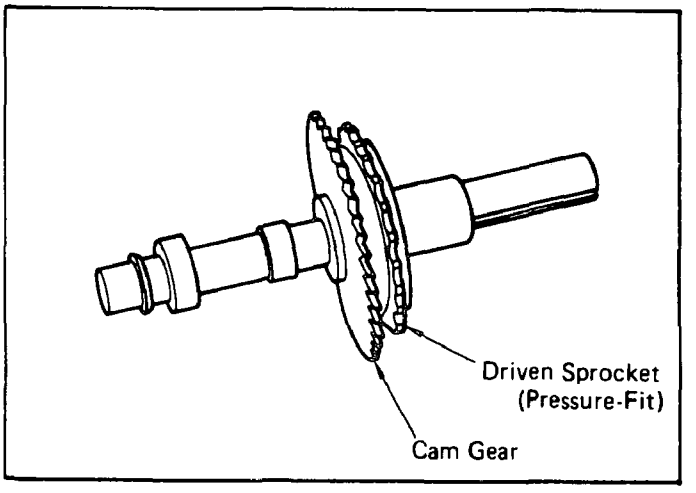


Fig. 9 (EY15B)

4-6 VALVE ARRANGEMENT

The exhaust valve is located upstream of the cooling air with the result that the exhaust valve is intensively cooled for improved engine durability. The inner side of the valve head is reinforced with hard alloy fused to it for added durability. (See Fig. 10.)

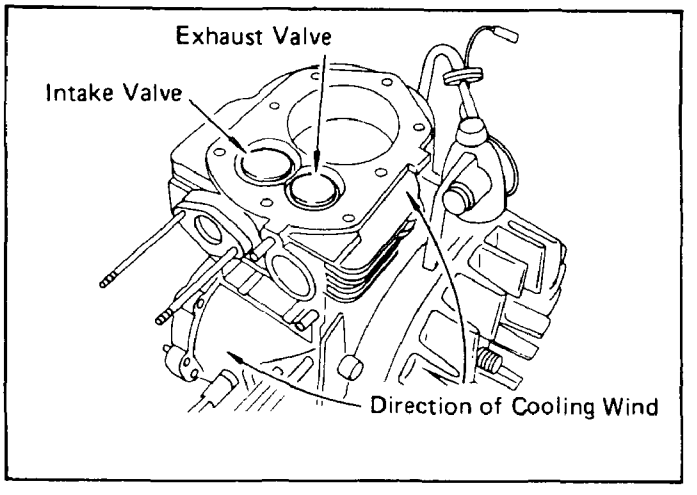


Fig. 10

4-7 CYLINDER HEAD

The cylinder head is an aluminum die casting, and forms a Ricardo type combustion chamber with ample area for high combustion effeciency. The spark plug is tilted for easy mounting of the fuel tank.
(See Fig. 11.)

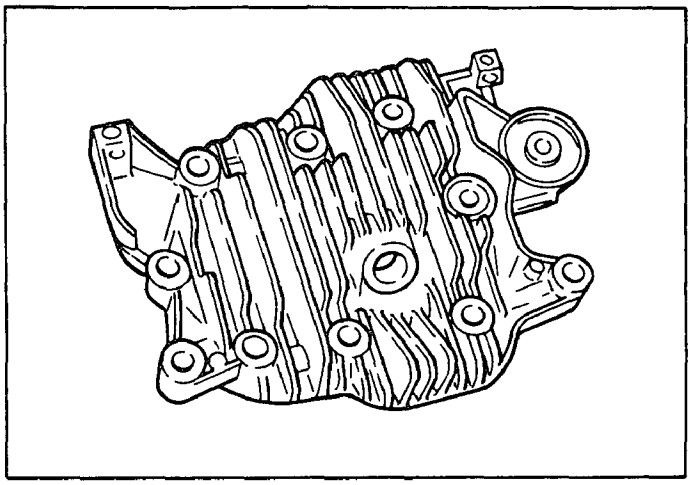


Fig. 11

4-8 GOVERNOR

The governor is a centrifugal flyweight type which permits constant operation at the selected speed against load variations. Governor gear is installed on the bearing cover without fail, and it engages with the cam gear after reassembling.
(See Fig. 12.)

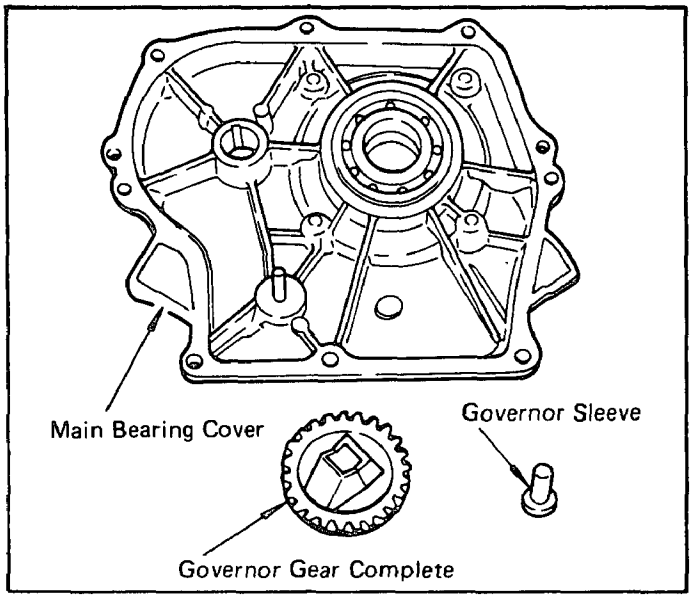


Fig. 12

4-9 COOLING

The cooling fan serving also as a flywheel cools the cylinder and cylinder head by forced air cooling. Cylinder baffles and head cover are provided for guiding the cooling air.

4-10 LUBRICATION

The rotating and sliding parts are being lubricated by scooping and splashing the oil in the crankcase with the oil scraper attached to the connecting rod.
(See Fig. 13.)

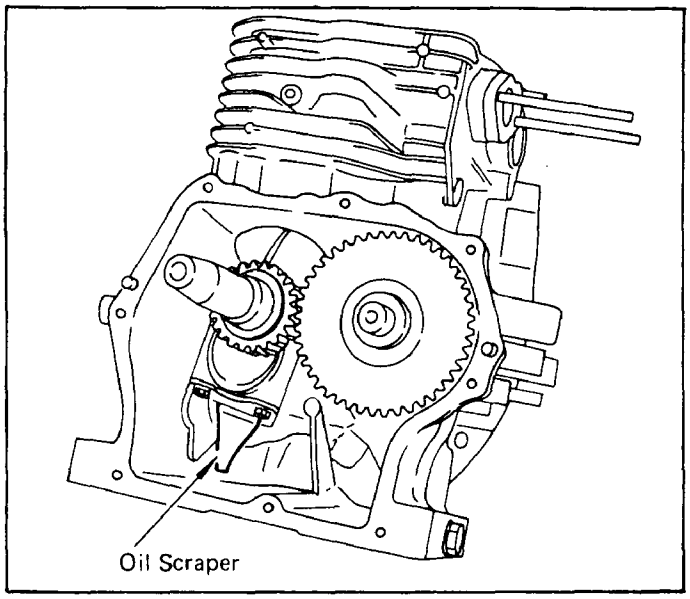


Fig. 13

4-11 IGNITION

The ignition system is a flywheel magneto type with ignition timing set at 23° before TDC. The magneto is composed of a flywheel and ignition coil. The flywheel serving also as a fan is mounted directly on the crankshaft, and the ignition coil in the crankcase. (For further details, refer to Section on the Magneto.) (See Fig. 14 and Fig. 15.)

(BREAKER POINT IGNTION TYPE)

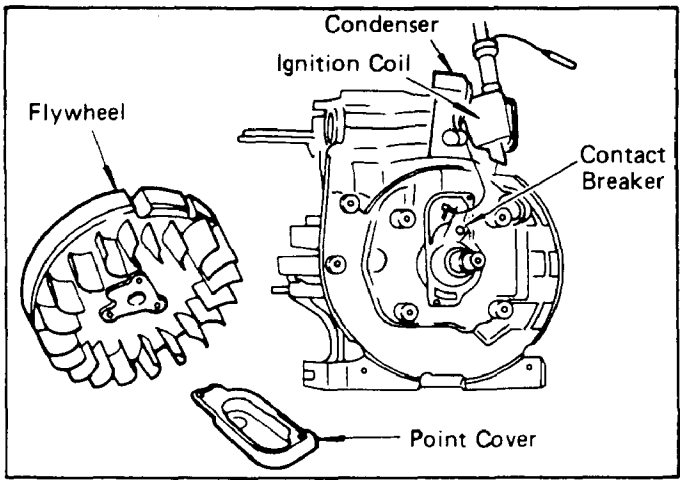


Fig. 14

(SOLID STATE IGNITION TYPE)

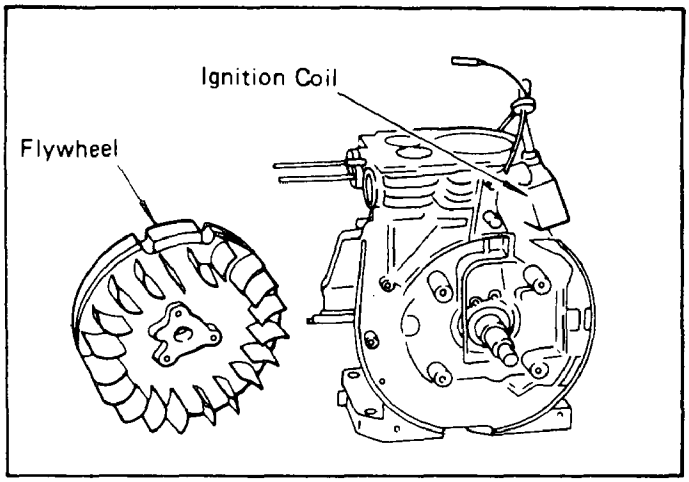


Fig. 15

4-12 CARBURETOR

A horizontal draft carburetor is employed. It has been carefully set after thorough tests to assure satisfactory start up, acceleration, fuel consumption, output performance etc.
For construction and order details, refer to the Section on Carburetor Construction, Disassembly and Reassembly.
(See Fig. 16.)

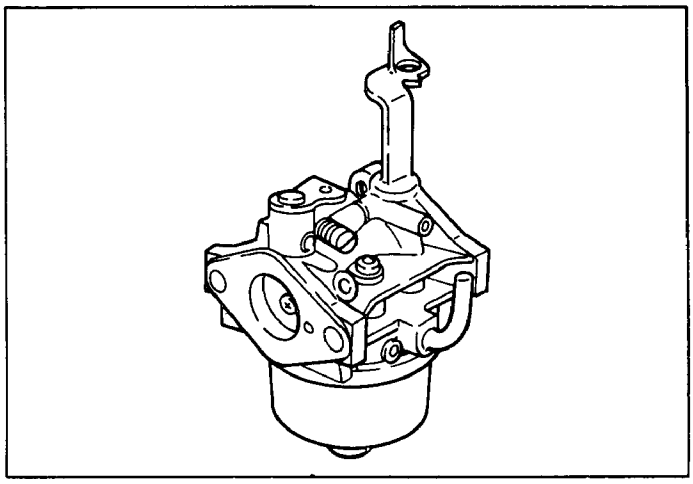


Fig. 16

4-13 AIR CLEANER

The air cleaner of the standard type engine is an oblong type using a sponge element. (A cyclone type semi-wet double element air cleaner is optionally available.)
(See Fig. 17.)

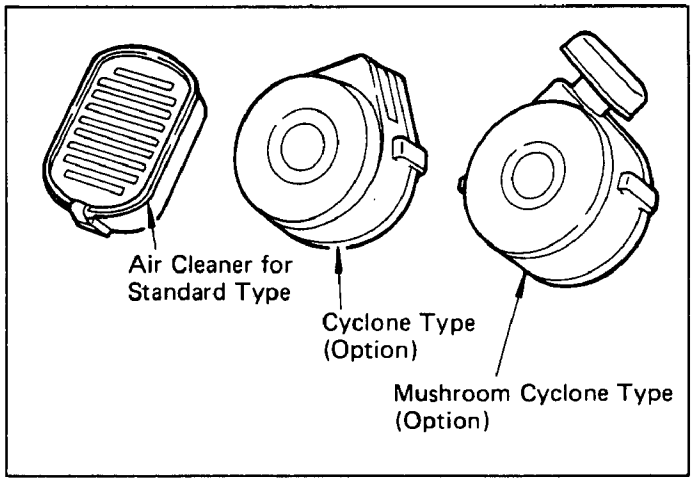
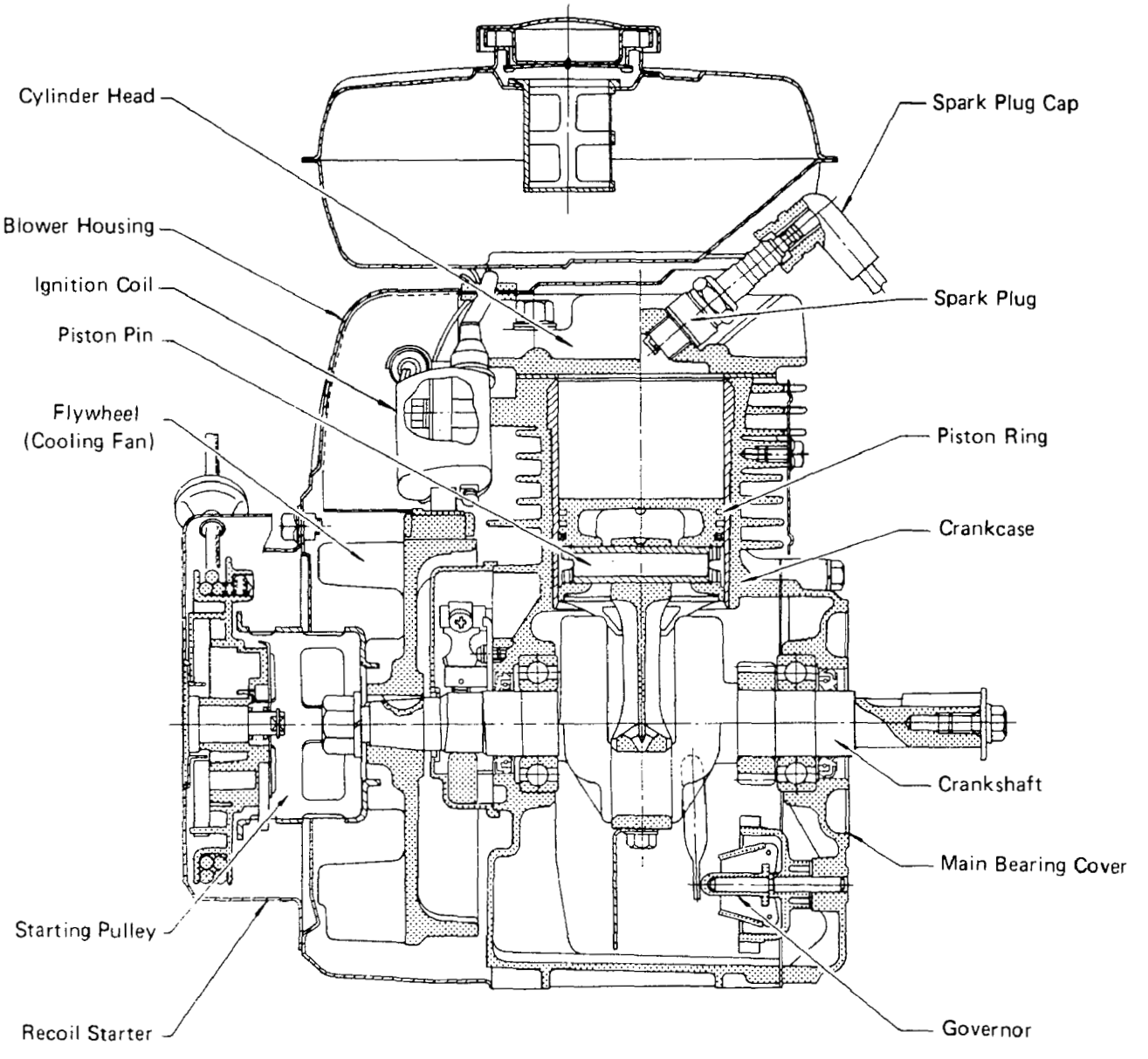


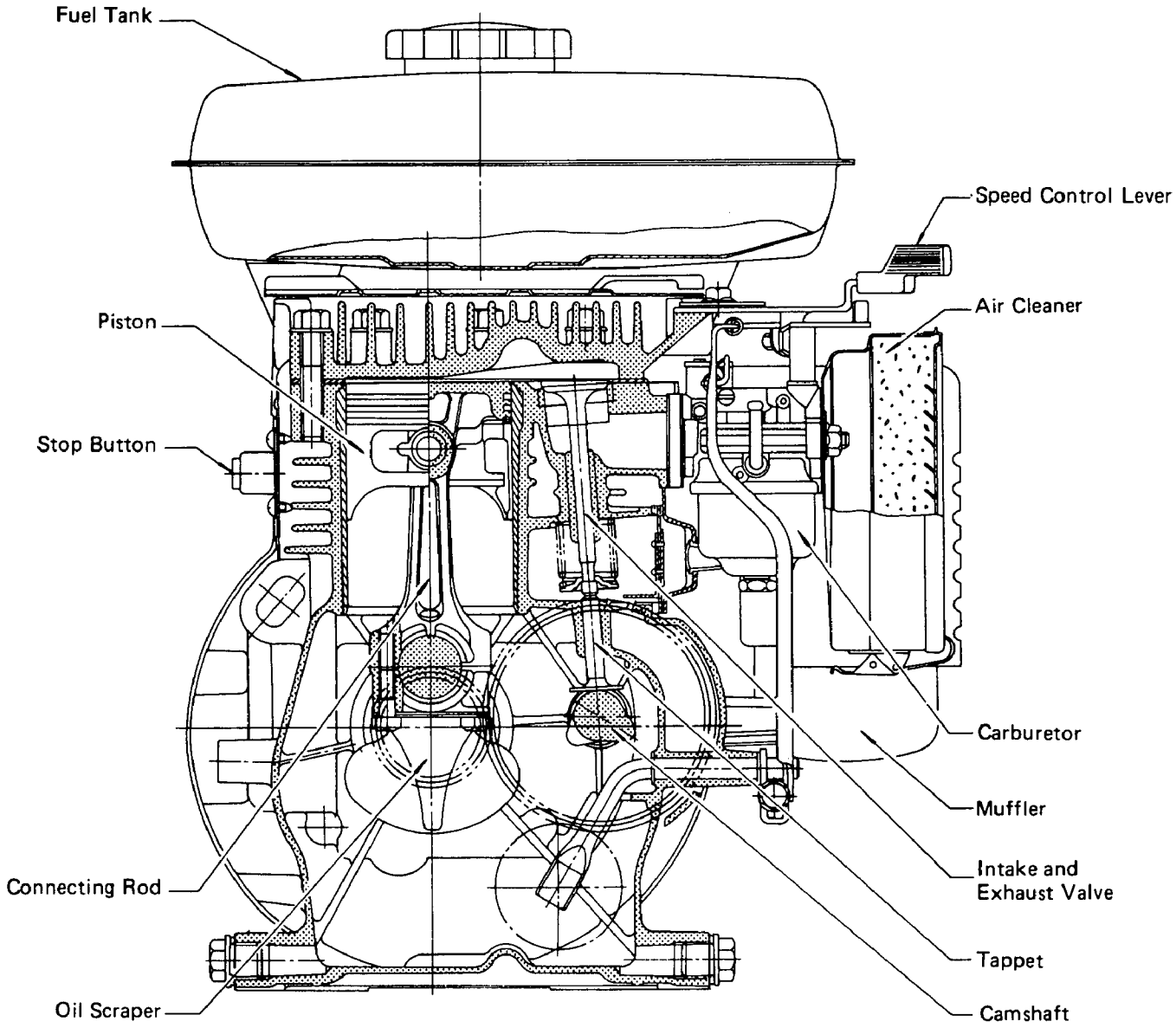
Fig. 17

4-14 SECTIONAL VIEW OF ENGINE

4-14-1 MODEL EY15D

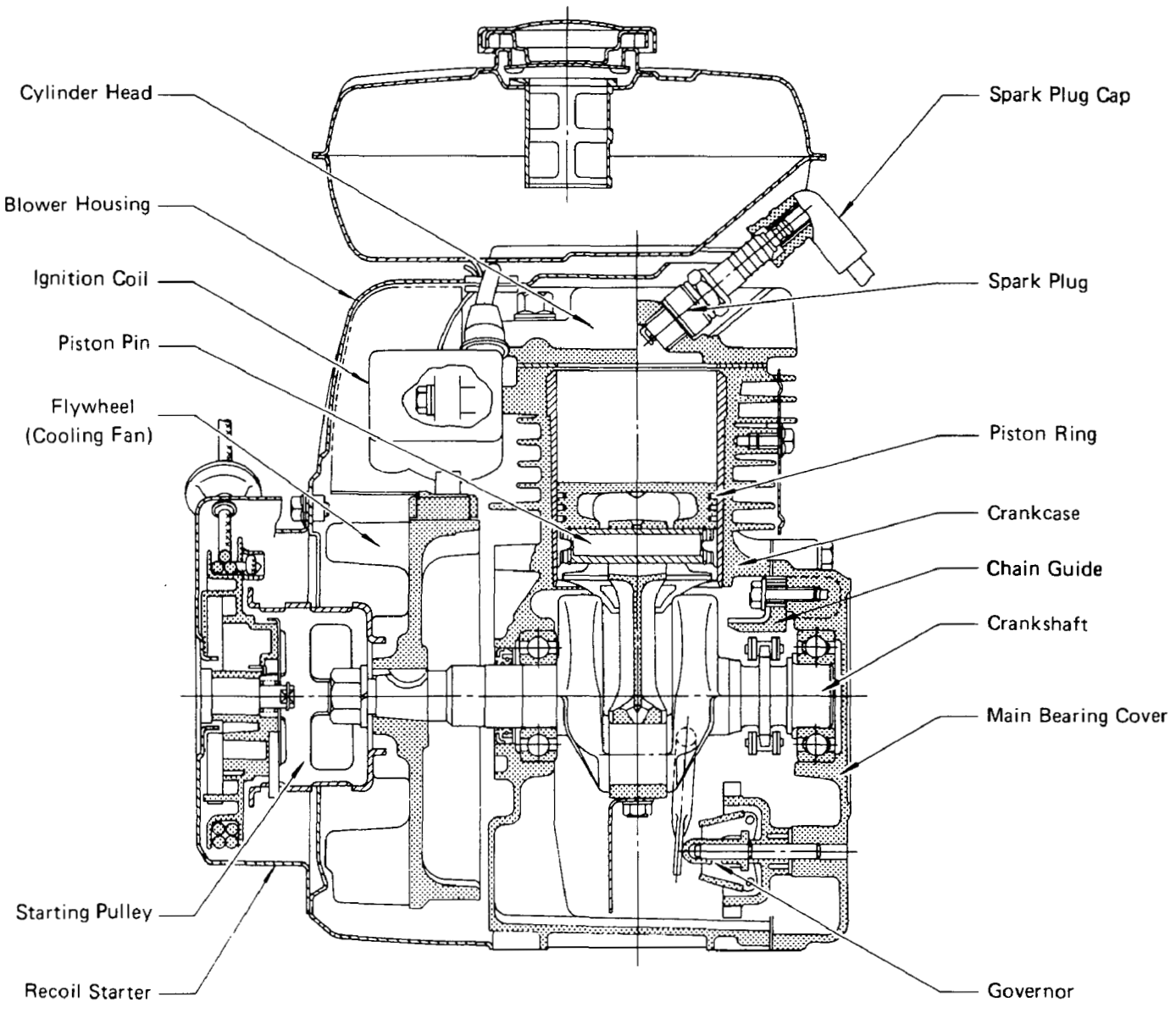


MODEL EY15D
(BREAKER POINT IGNITION TYPE)

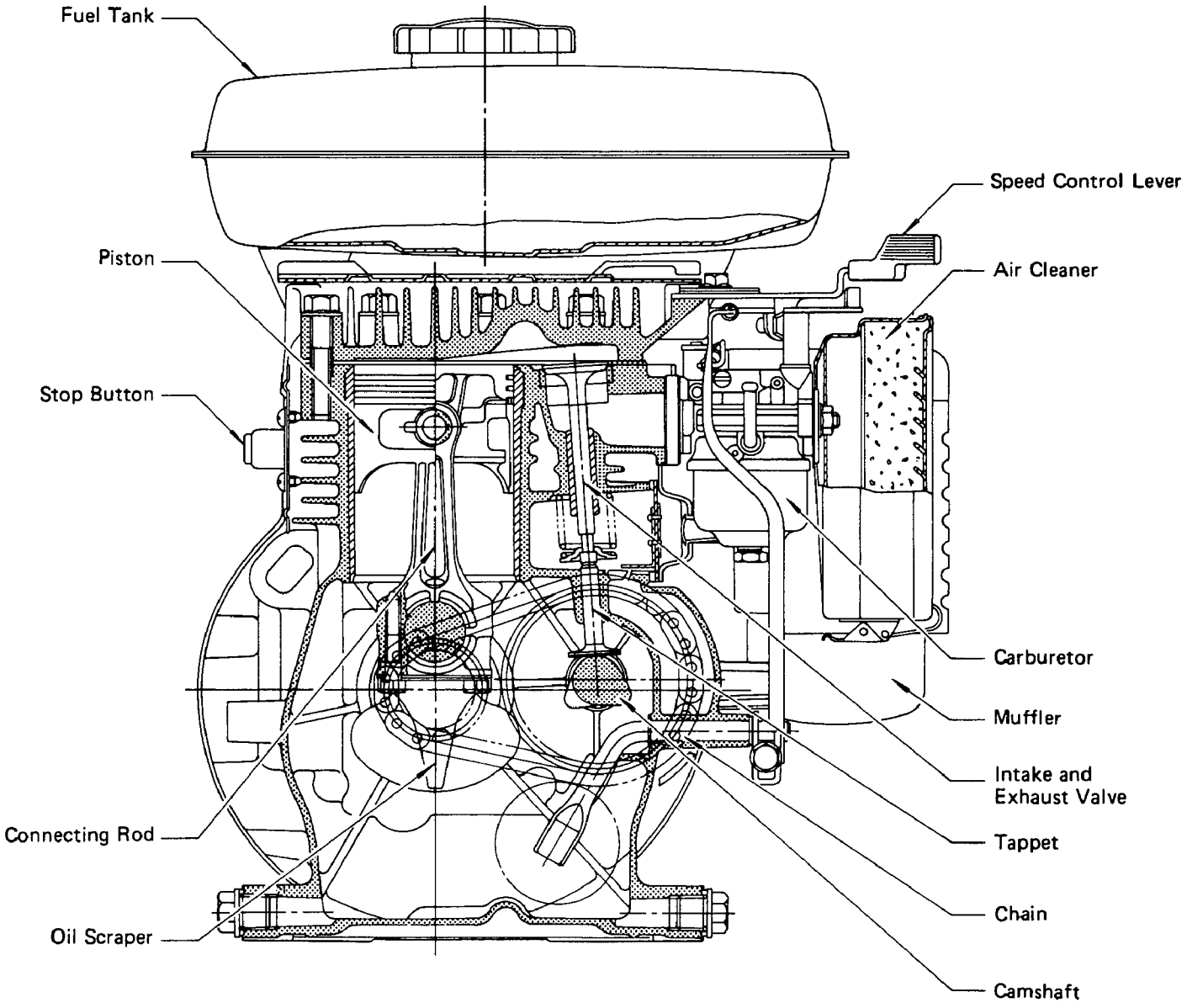

Fuel Tank
Speed Control Lever
Air Cleaner
Piston
Stop Button
Carburetor
Muffler
Intake and
Exhaust Valve
Connecting Rod
Tappet
Oil Scraper
Camshaft

MODEL EY15D

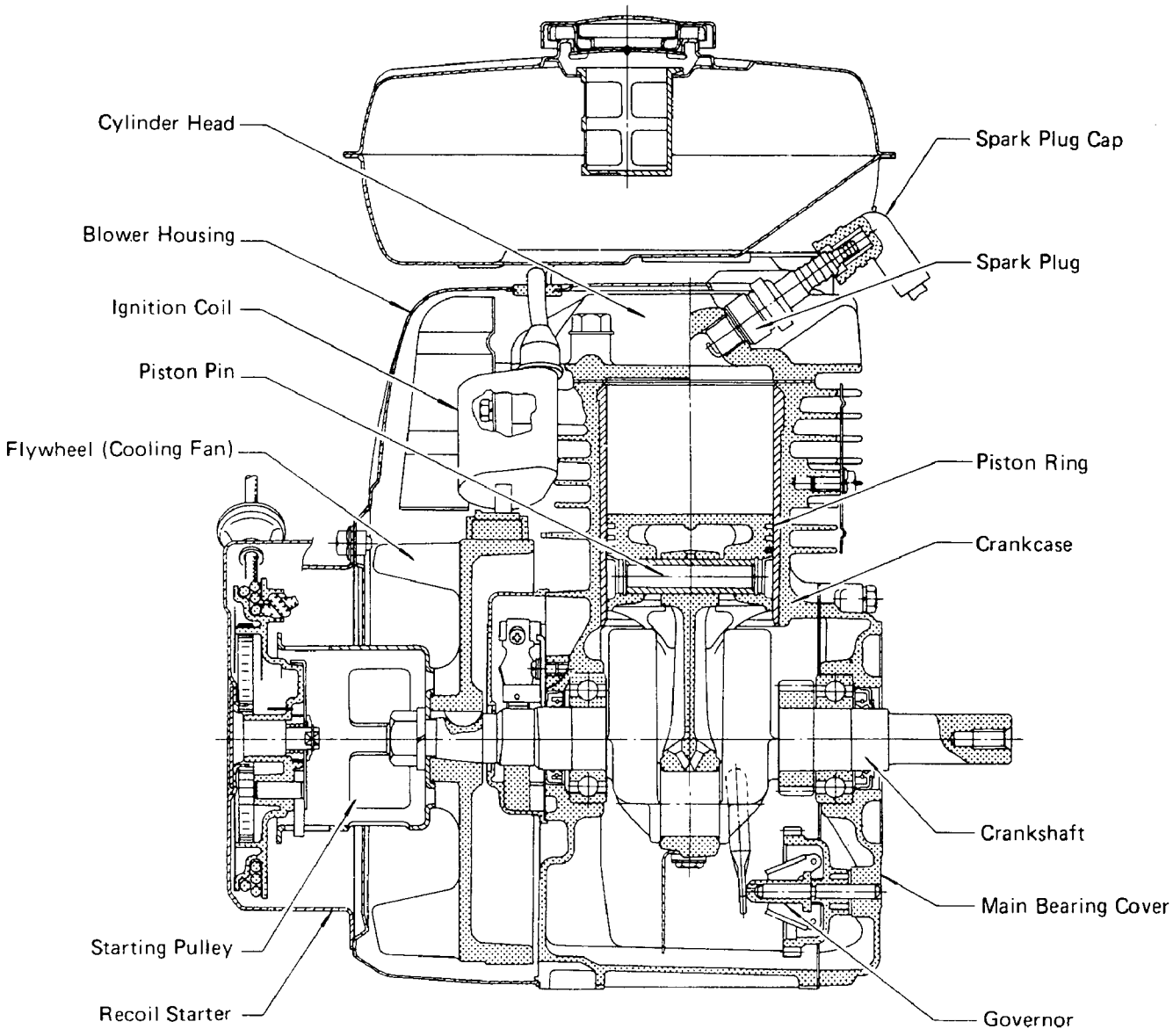
4-14-2 MODEL EY15B



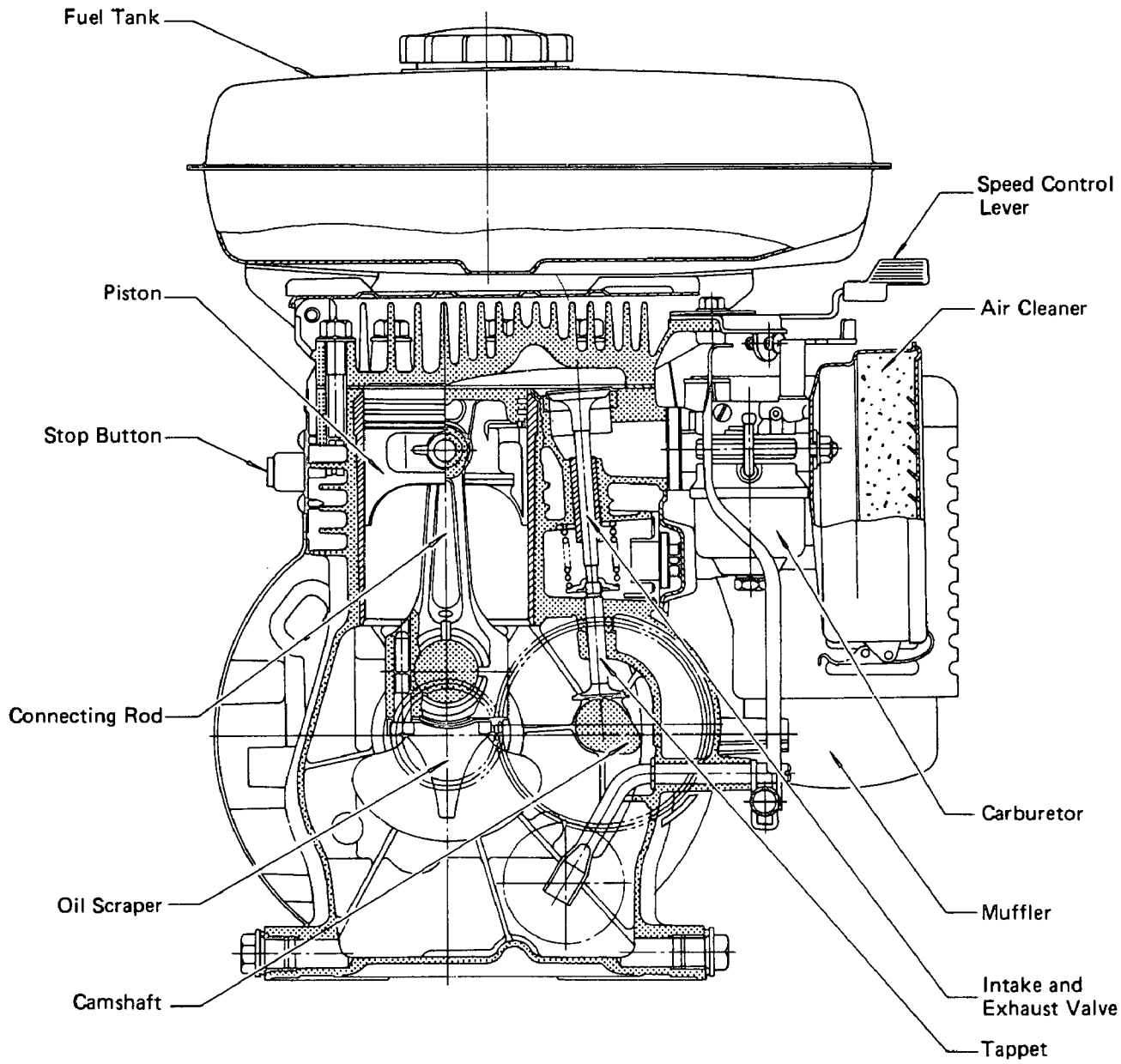
MODEL EY15B
(SOLID STATE IGNITION TYPE)


Fuel Tank
Speed Control Lever
Piston
Air Cleaner
Stop Button
Carburetor
Muffler
Intake and
Exhaust Valve
Connecting Rod
Tappet
Chain
Oil Scraper
Camshaft

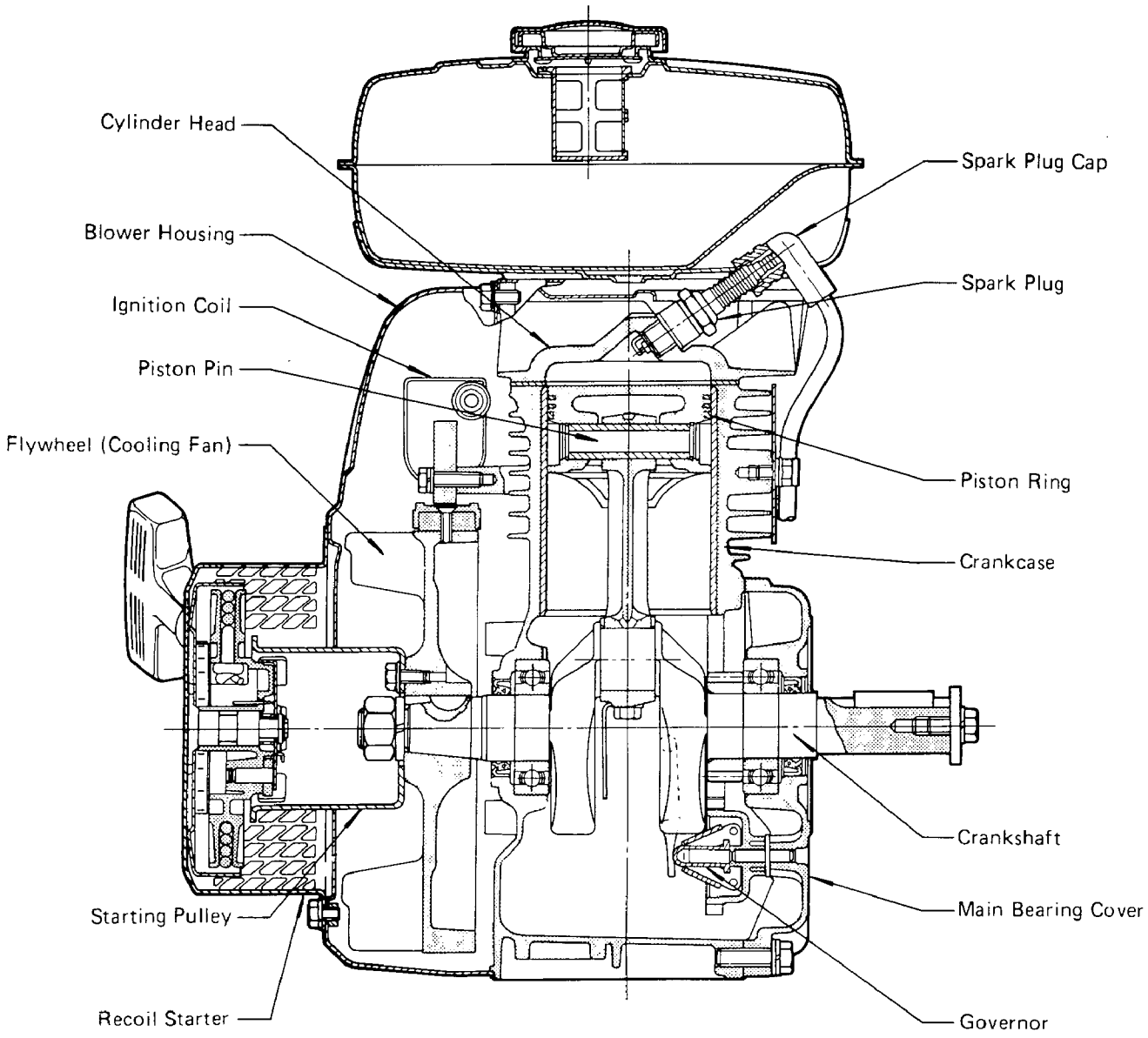
MODEL EY15B



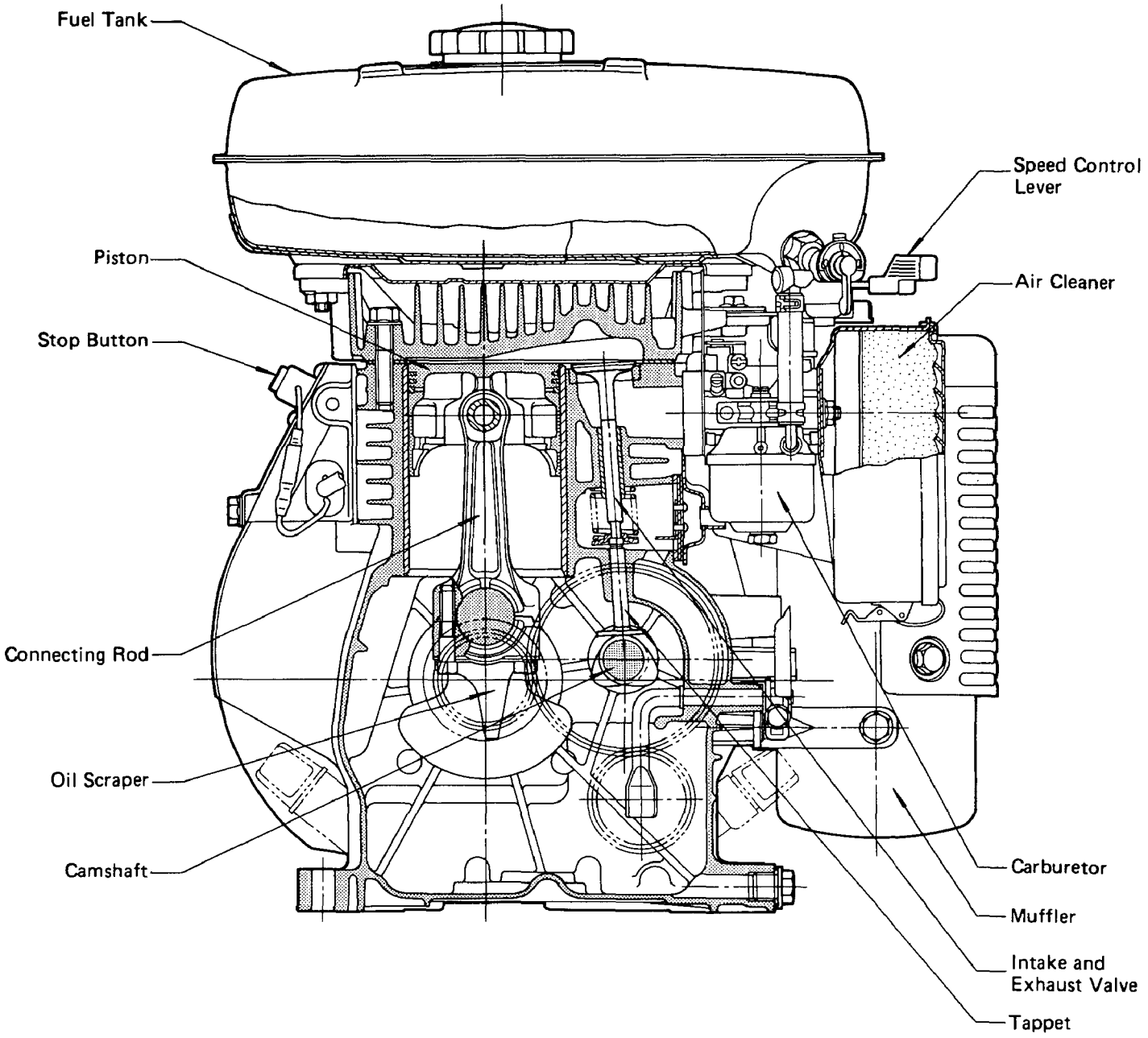
MODEL EY20D
(BREAKER POINT IGNITION TYPE)


Fuel Tank
Speed Control Lever
Piston
Air Cleaner
Stop Button
Connecting Rod
Carburetor
Muffler
Oil Scraper
Intake and Exhaust Valve
Camshaft
Tappet

MODEL EY20D



MODEL EY28
(SOLID STATE IGNITION TYPE)


Fuel Tank
Speed Control Lever
Piston
Air Cleaner
Stop Button
Connecting Rod
Oil Scraper
Camshaft
Carburetor
Muffler
Intake and Exhaust Valve
Tappet

MODEL EY28

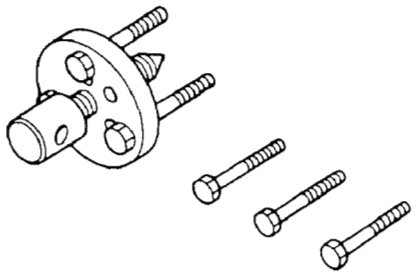
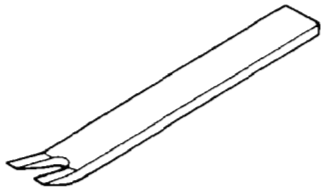
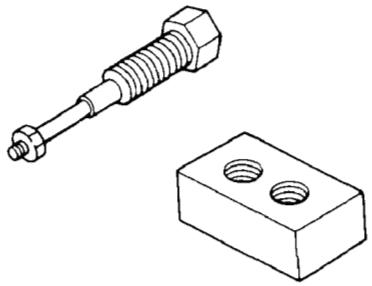
5. DISASSEMBLY and REASSEMBLY

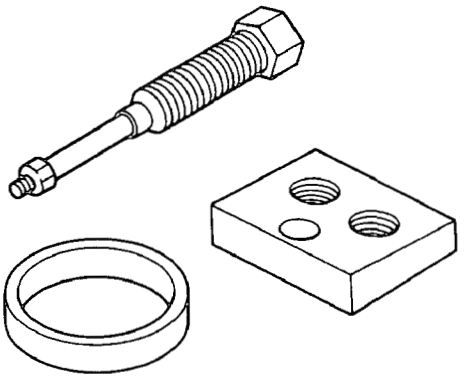
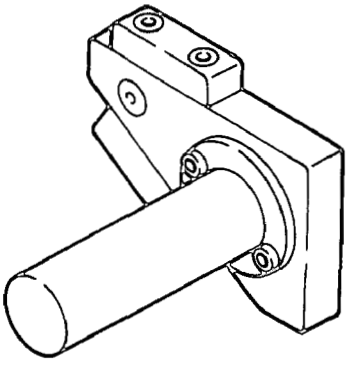
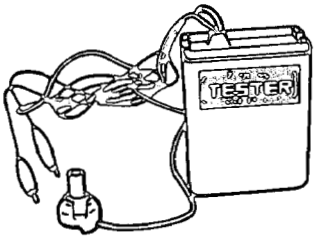
5-1 PREPARATIONS and SUGGESTIONS

1) When disassembling the engine, remember well the locations of individual parts so that they can be reassembled correctly. If you are uncertain of identifying some parts, it is suggested that tags be attached to them.
2) Have boxes ready to keep disassembled parts by group.
3) To prevent missing and misplacing, temporarily assemble each group of disassembled parts.
4) Carefully handle disassembled parts, and clean them with washing oil.
5) Use the correct tools in the correct way.

5-2 SPECIAL TOOLS

For your reference, the following shows special tools of Robin Engine for Disassembly, Measuring and Inspection Instruments.

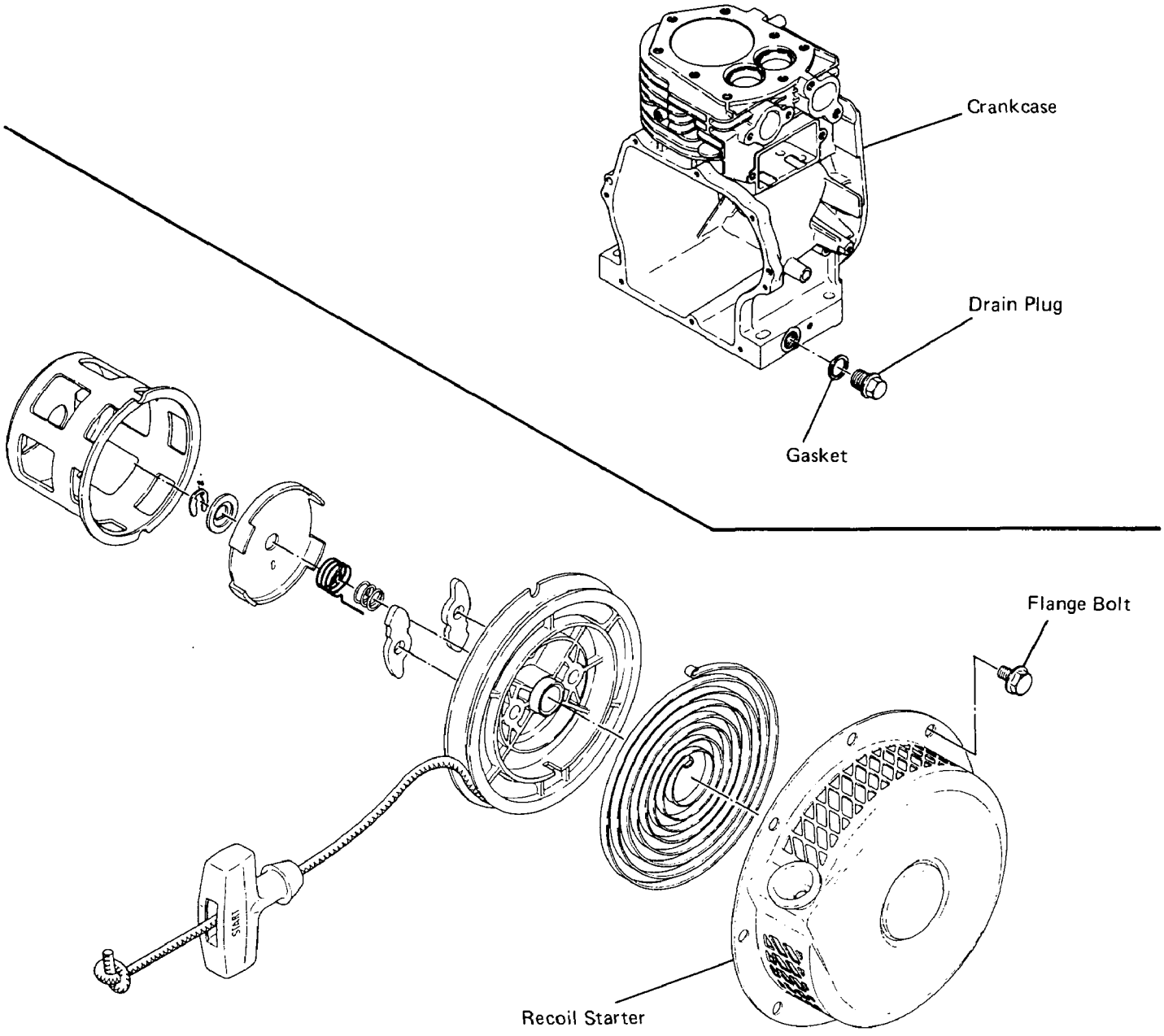
Part No.	Tool	Use	Applicable Model	Shape
209 95004 07	Flywheel Puller (with bolt)	For pulling off Flywheel	EY08 EY10, 13, 14 EY15, 18, 20 EY23, 25, 27 EY28, 33, 35 EY40, 44 EC05, 07, 10 EC17, 25, 37	
230 95001 07	Valve Spring Retainer	For mounting and dismounting Valve Spring Retainer and Retainer Lock	EY08	
227 95003 07			EY10, 13, 14 EY15, 18, 20 EY23, 25, 27 EY28, 33, 35 EY40, 44	
230 95002 07	Valve Guide Puller	For pulling off Valve guide	EY08	
205 95001 07			EY10 EY13, 14	

Part No.	Tool	Use	Applicable Model	Shape
206 95001 07	Valve Guide Puller	For pulling off Valve guide	EY18, 23	
227 95001 07			EY15, 20	
234 95001 07			EY28	
207 95001 07			EY25, 27	
226 95001 07	Guide (Chain Guide)	For mounting chain guide	EY15B	
M-20248	Timing Tester	For adjusting timing	EY10, 13, 14 EY15, 18, 20 EY25, 27 EY33, 35, 40 EY44 EC03, 04, 05 EC07, 10, 17 EC25, 37	

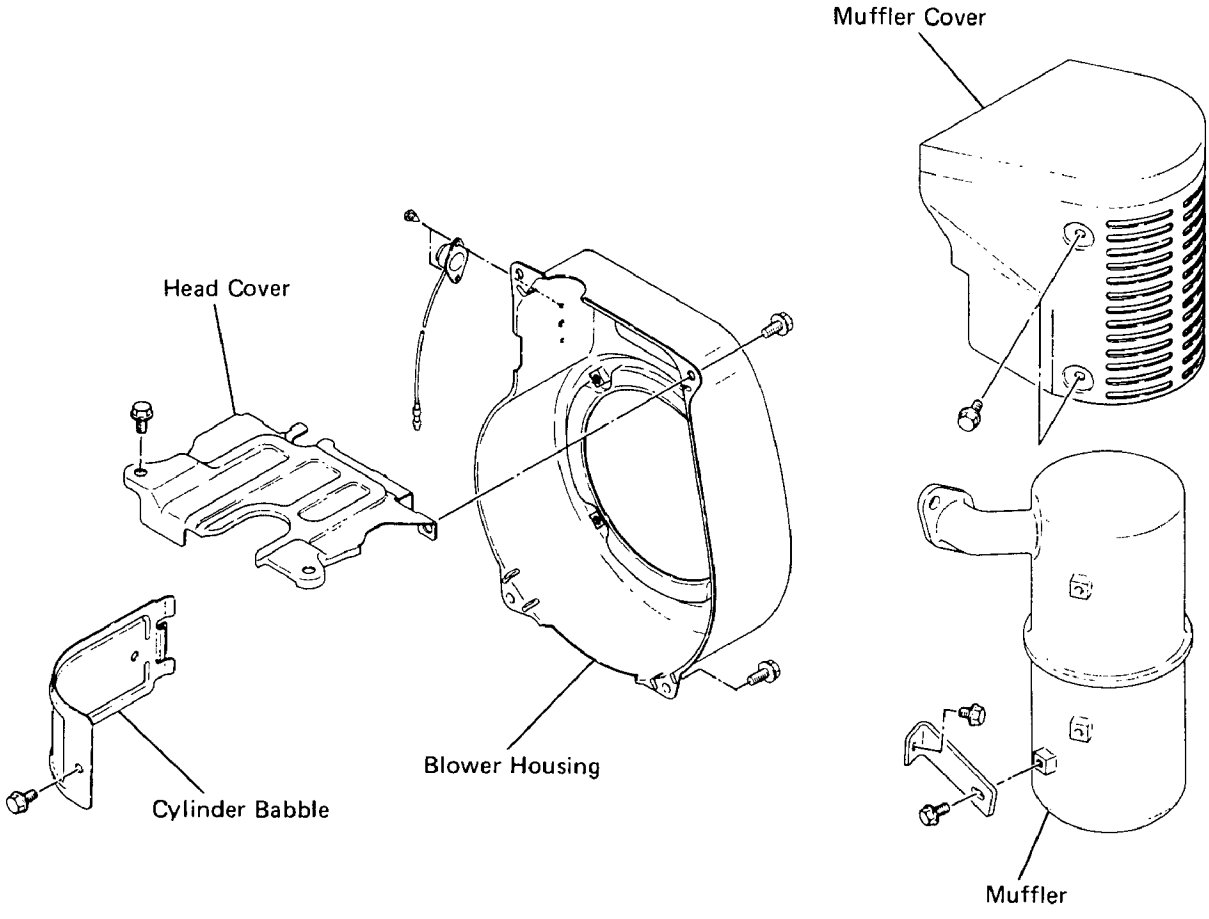
5-3 HOW TO DISASSEMBLE

*Length of the bolt indicates the length from the bolt head bottom surface to the threaded end.

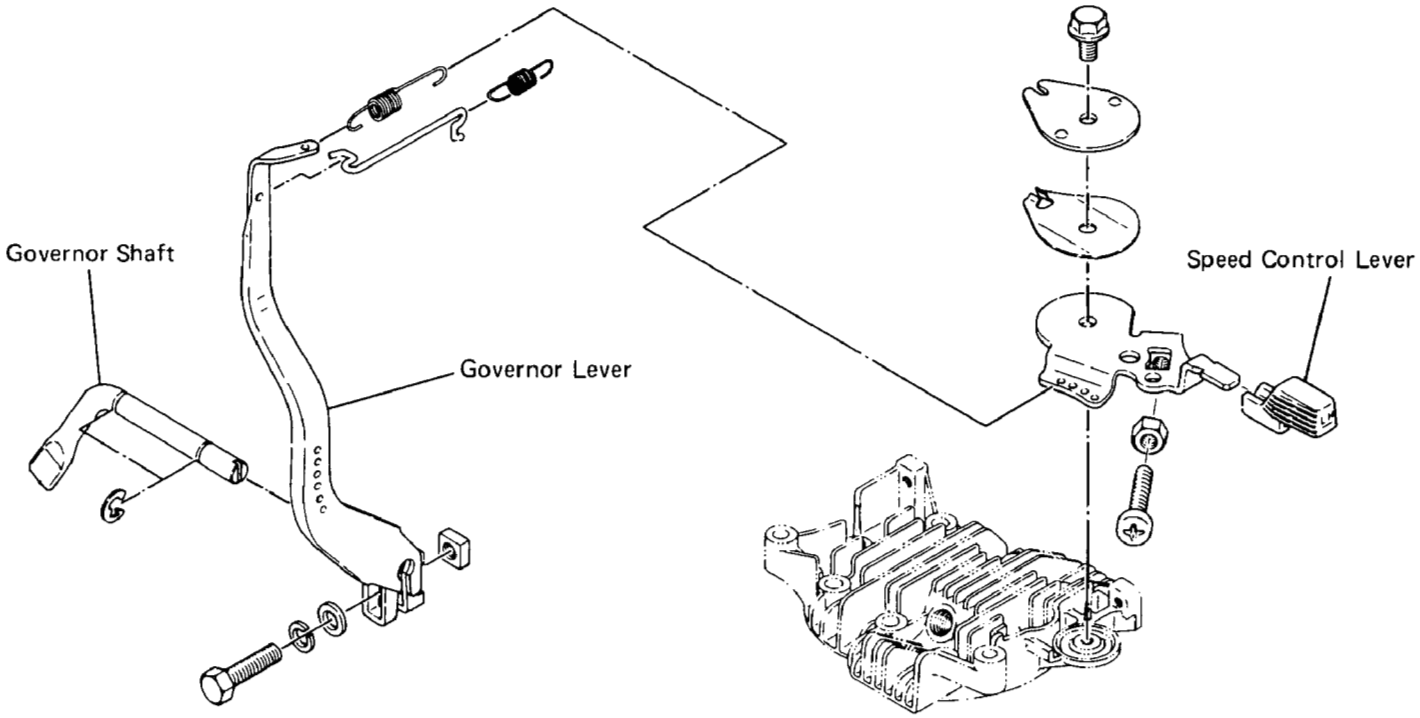
Order	Item	Procedures	Remarks	Tool
1	Drain plug	(1) Drain engine oil. Drain plugs on both sides of the crankcase.	Be careful not to lose the gasket.	14 mm spanner
2	Recoil starter	(1) Remove the recoil starter. 6ϕ x 8 mm Flange bolt: 4 pcs.		10 mm box spanner



Order	Item	Procedures	Remarks	Tool
3	Blower housing	(1) Remove the Blower housing from the crankcase and head cover. EY15, 20 . . . 6ϕ x 12 mm bolt: 2 pcs. 6ϕ x 14 mm bolt: 2 pcs. EY28 . . . . . 6ϕ x 12 mm bolt: 4 pcs.	Fastened together with the fuel tank	10 mm box spanner
4	Fuel tank and head cover	(1) Close the fuel cock. (2) From the carburetor disconnect the fuel pipe between the fuel strainer and carburetor on the side of the fuel strainer. (3) Remove the fuel tank from the cylinder head. EY15, 20 . . . 6ϕ nut: 2 pcs. EY28 . . . . . 8ϕ nut: 4 pcs. (4) Remove the head cover from the cylinder head.		10 mm spanner or 12 mm spanner
5	Air cleaner	(1) Remove the air cleaner cover and element. (2) Remove the air cleaner case from the carburetor. 6ϕ nut: 2 pcs. (3) Disconnect the breather pipe.	Air cleaner is fastened together with the carburetor.	10 mm box spanner
6	Muffler cover	(1) From the muffler remove muffler cover. EY15, 20 . . . 6ϕ x 8 mm bolt: 3 pcs. EY 28 . . . . . 6ϕ x 8 mm bolt: 4 pcs.		10 mm box spanner
7	Muffler	(1) Remove the muffler from the cylinder portion of the crankcase. 8ϕ nut: 2 pcs.	Brass nut	12 mm spanner



Order	Item	Procedures	Remarks	Tool
8	Governor lever and the relative parts	(1) Remove the governor lever from the governor lever shaft. 6ϕ x 25 mm bolt: 1 pce. (2) Remove the governor rod and rod spring from the carburetor.	Just loosen the bolt, unnecessary to take out the bolt.	10 mm box spanner or 10 mm spanner
9	Carburetor	(1) Remove the carburetor from the cylinder portion of the crankcase.		



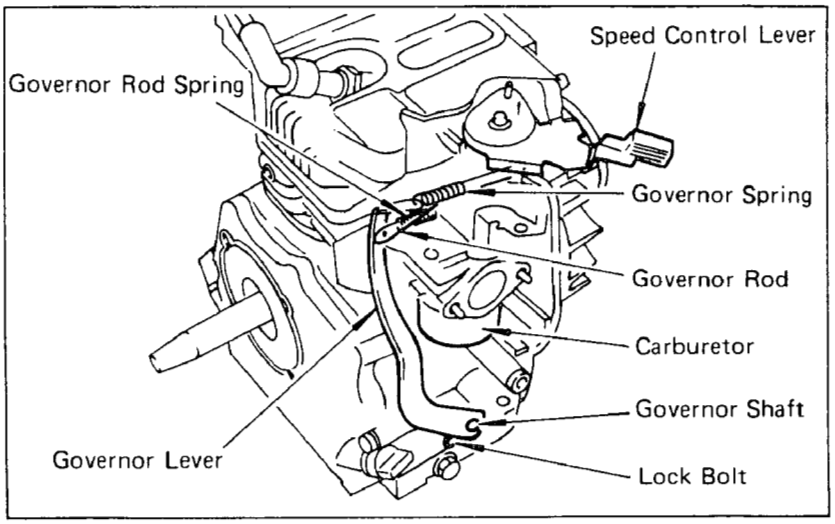
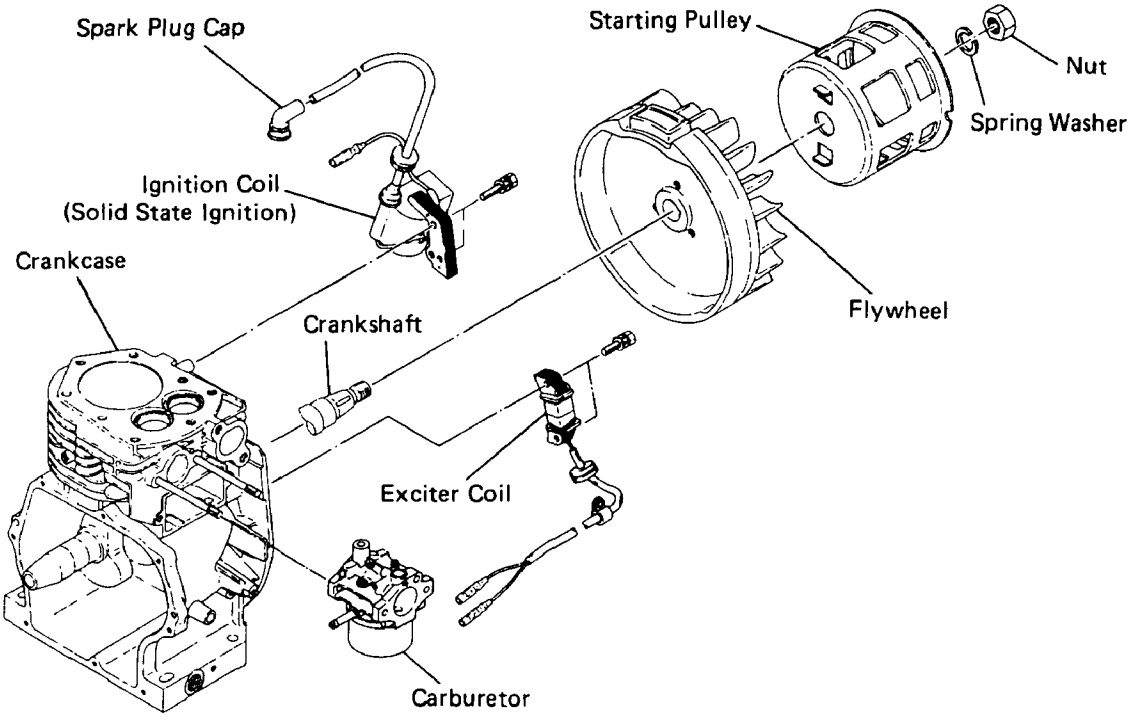


Fig. 18

Order	Item	Procedures	Remarks	Tool
10	Starting pulley	(1) Remove the starting pulley from the flywheel. 6ϕ x 12 mm bolt: 3 pcs. Fit a box or socket wrench over the flywheel nut, and strike it hard with a hammer to remove the nut (EY15, 20: 14 mm, EY28: 18 mm) and spring washer.	Be careful not to damage the blades of the flywheel with a driver and a like. Strike counterclockwise with a hammer. (See Fig. 19.)	10 mm box spanner 19 mm box spanner or 24 mm box spanner
11	Flywheel	(1) Remove the flywheel from the crankshaft.	Fit the flywheel puller as shown in Fig.20, turn the center bolt clockwise and pull out the flywheel.	Flywheel puller
12	Ignition coil	(1) Remove the ignition plug cap from the ignition plug; and remove the ignition coil from the crankcase. 6ϕ x 25 mm bolt: 2 pcs.	Sems bolt	10 mm box spanner



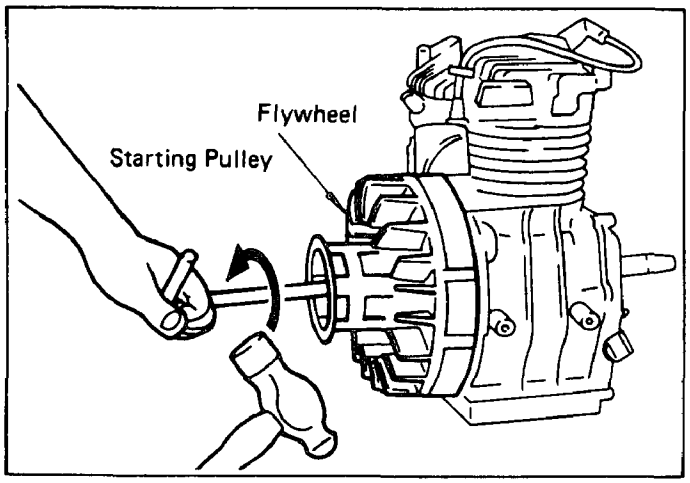


Fig. 19

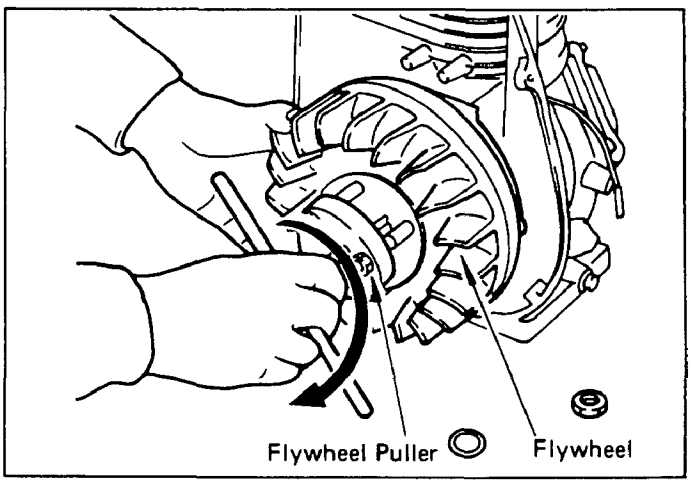
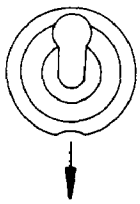
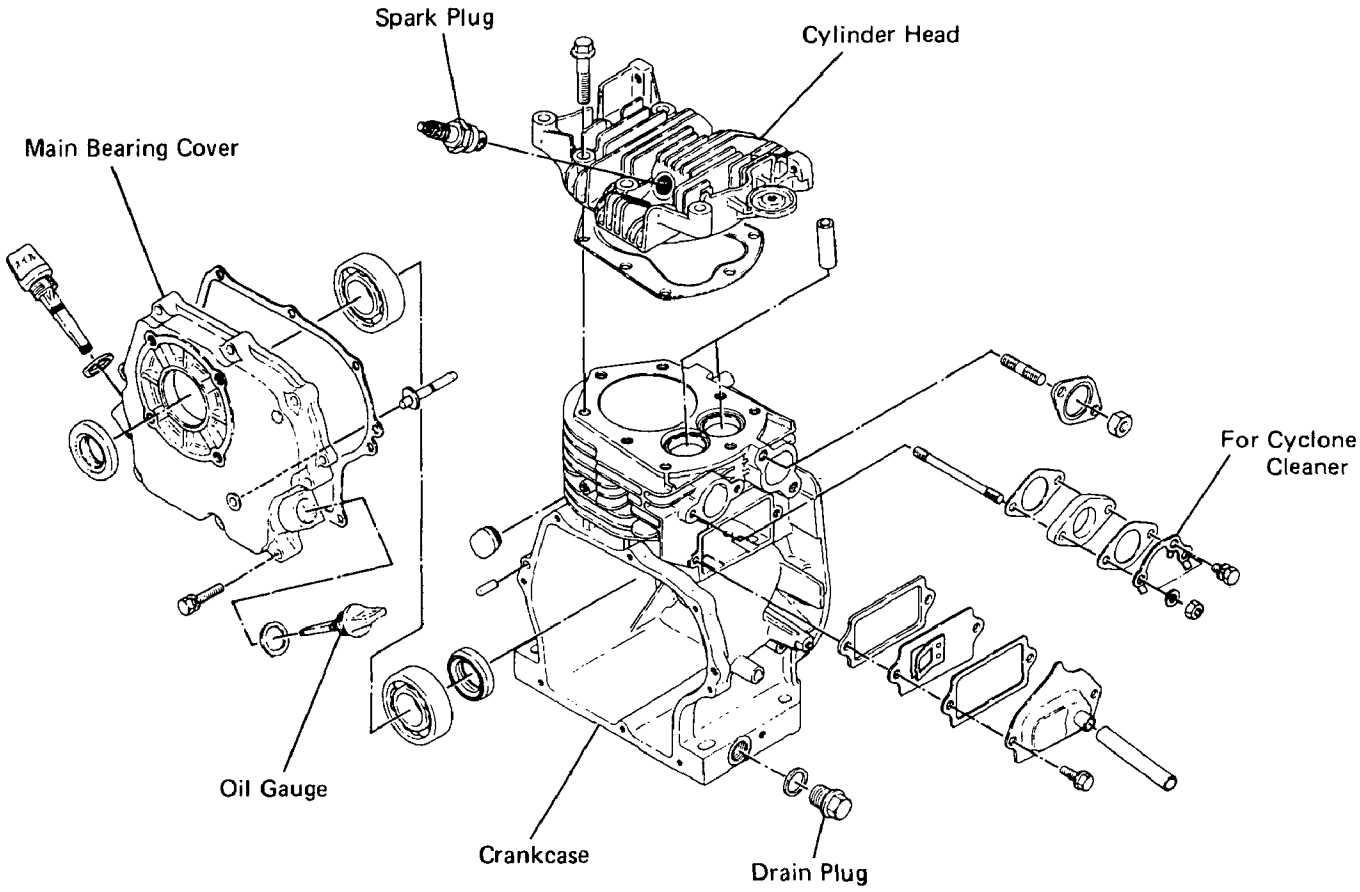


Fig. 20

Order	Item	Procedures	Remarks	Tool
13	Spark plug	(1) Remove the spark plug from the cylinder head.		21 mm box spanner
14	Cylinder head	(1) Remove the 8 mm bolt and remove the cylinder head from the crankcase. 8ϕ x 40 mm bolt: 8 pcs. (2) Remove the cylinder head gasket from the crankcase.		12 mm box spanner
15	Intake and exhaust valve	(1) Remove the inner and outer tappet covers from the crankcase. 6ϕ x 12 mm bolt: 2 pcs. (2) Pull out the intake and exhaust valve. (3) Remove the valve spring and the valve retainer.	Put the notch on the outer circumference of the spring retainer on this side. Hook the medium size (–) drive at the dent (lower side) of the spring retainer and pull out the valves, while pulling the spring retainer toward you. (See Fig. 21.)	10 mm box spanner  The front is this side. (–) driver
16	Main bearing cover	(1) From the crankcase remove the bolt fastening the main bearing cover. EY15, 20 . . . 6ϕ x 30 mm bolt: 8 pcs. EY28 . . . . . 8ϕ x 28 mm bolt: 8 pcs. (2) Remove the cover, lightly tapping the cover evenly with a plastic hammer.	Sems bolt Be careful not to damage the oil seal. (See Fig. 22.)	10 mm box spanner



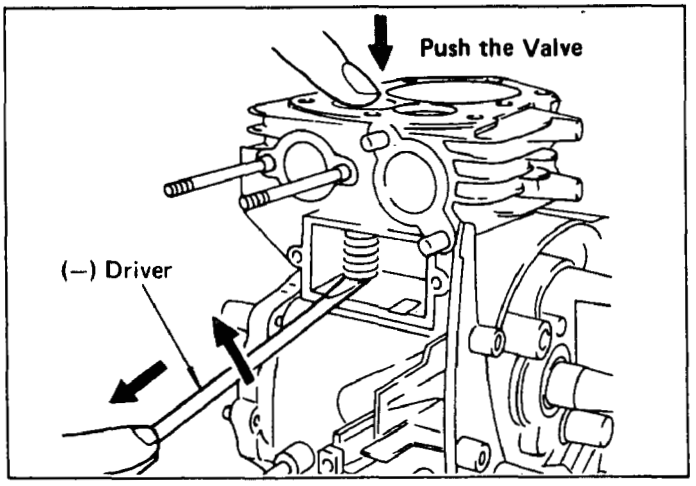


Fig. 21

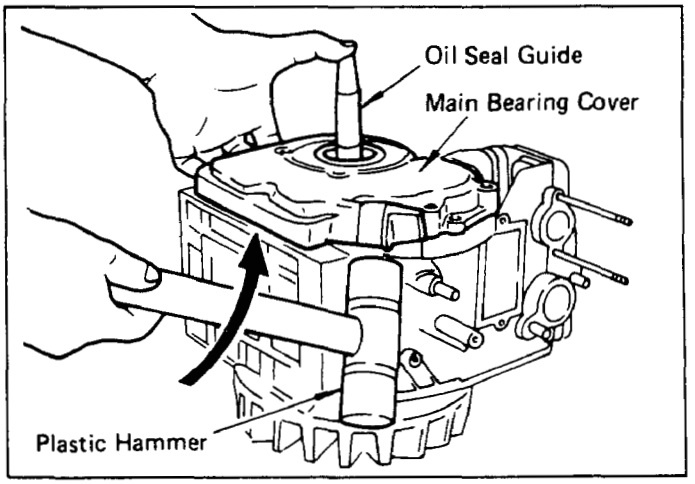
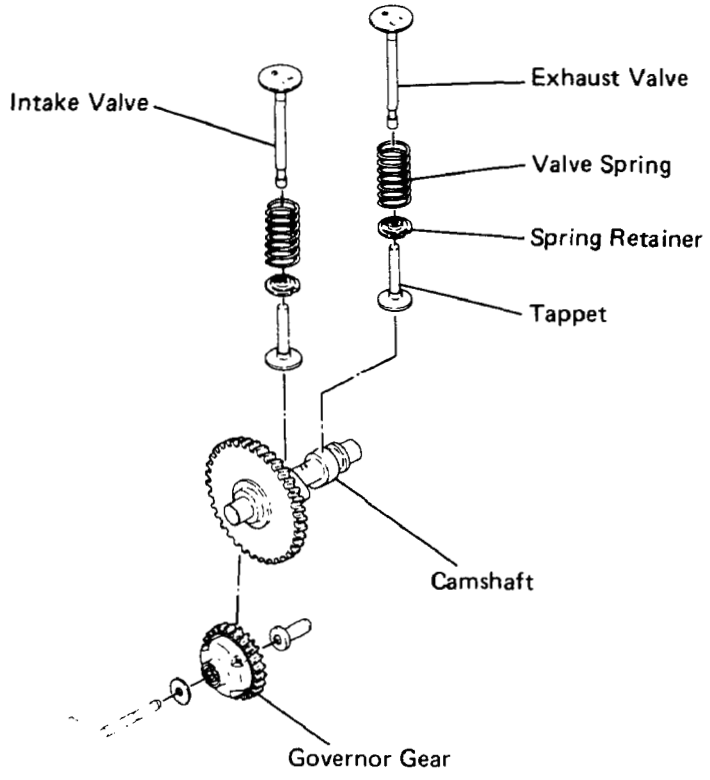


Fig. 22

Order	Item	Procedures	Remarks	Tool
17	Camshaft	(1) Remove the camshaft from the crankcase.	To prevent the tappets from falling or damaging, place the crankcase on the side. (See Fig. 23.)	
18	Tappet	(1) Remove the tappets from the crankcase.	Before removing put a mark of intake or exhaust on each tappet. In the EY15B type, remove the tappets after step 21.	



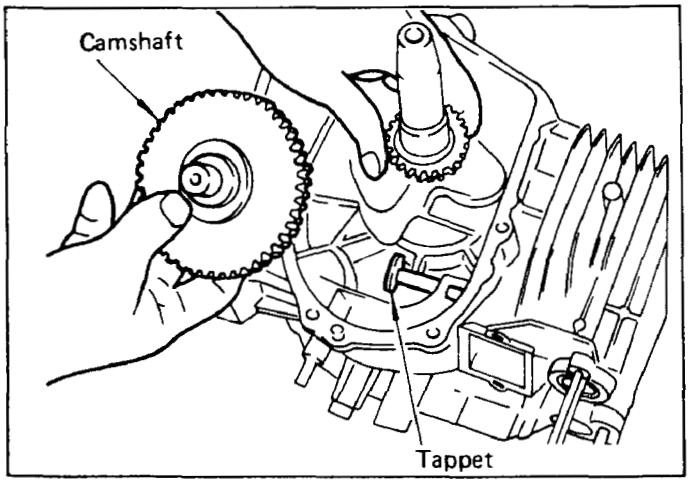
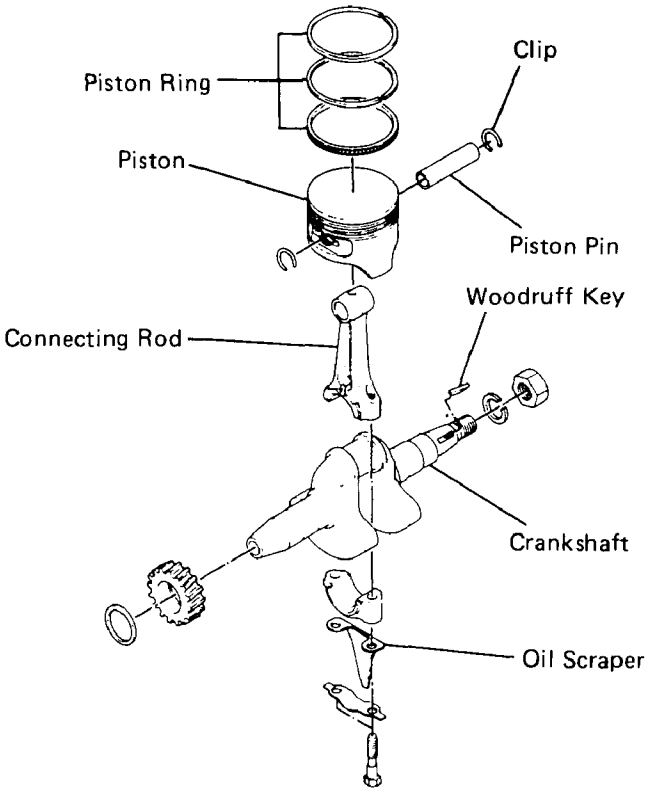


Fig. 23

Order	Item	Procedures	Remarks	Tool
19	Connecting rod and piston	(1) Scrape off carbon and other foreign deposits from the upper parts of the cylinder and piston, and then straighten out the bent tabs of the lock washers on the connecting rod, and remove two pieces of the bolt. (2) Remove the oil scraper, lock washer and connecting rod cap from the crankshaft. (3) Turn the crankshaft until the piston is raised up to the highest position, push the connecting rod up, and remove the piston out of the top of the cylinder.	In the EY15B type, move the connecting rod to the position shown in Fig. 24.	10 mm box spanner or 10 mm spanner
20	Piston and piston pin	(1) Remove the two clips, pull out the piston pin, and take the piston off from the small end of the connecting rod. (2) Spread the open ends of the piston rings and remove them from the piston.	Be careful not to damage the inside of the small end of the connecting rod. Be careful not to break the rings by spreading too much.	
21	Crankshaft	(1) Remove the woodruff key (for the magneto).	Be careful not to damage the oil seal.	
		(2) Lightly hammer the magneto end of the crankshaft, and pull it out of the crankcase.		
22	Crankshaft Camshaft Chain (for EY15B)	(1) Remove the woodruff key (for the magneto). (2) Remove the crankshaft and the camshaft at the same time from the crankcase, tapping the crankshaft tip in the magneto side.	Be careful not to damage the oil seal. To prevent the tappets from failing or damaging, place the crankcase on the side.	



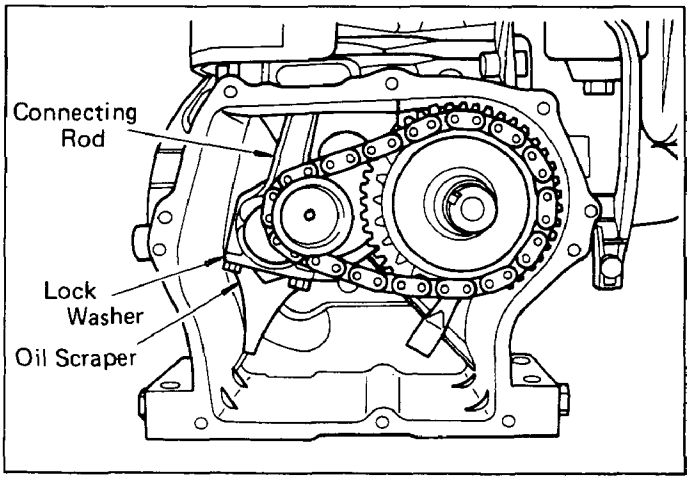


Fig. 24 (EY15B)

5-4 HOW TO REASSEMBLE

●Precaution in reassembling

1) Every and each part should be cleaned thoroughly. Especially, pay utmost care and attention to the cleanliness of the piston, cylinder, crankshaft, connecting rod and bearings.
2) Scrape completely off carbons from the cylinder head and the upper part of the piston; especially the carbon adhered in the groove of the piston ring should be carefully and completely taken out.
3) Carefully check the lip portion of every oil seal. If faulty one is found, replace it without any hesitation.
   Apply enough oil to the lip portion of the oil seal when reassembling.
4) Replace all the gaskets with new ones.
5) Replace the key, pin, bolt, nuts, etc. with new one, if necessary.
6) Whenever tightening torque is specified, conform to the specified figures.
7) Apply oil to the revolutionary parts and friction surfaces, when reassembling.
8) Check and adjust the clearances of various portions and then reassemble.
9) When some main portions are assembled in the course of reassembling, turn or move the gadgets by hand and pay attention to the frictional noise and resistance.

●Sequence and precautions in reassembling

5-4-1 CRANKSHAFT

1) Fit the oil seal guide onto the end of the crankshaft, and insert the crankshaft into the crankcase as shown in Fig. 25.

   NOTE: In case of not using the oil seal guide, be careful not to damage the oil seal lip.

2) Put woodruff key (for magneto) in place.

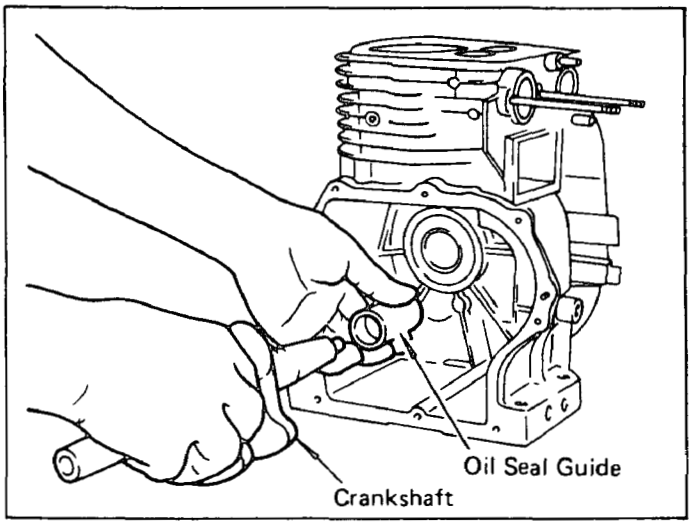


Fig. 25

3) DIMENSIONS of CRANKSHAFT PIN

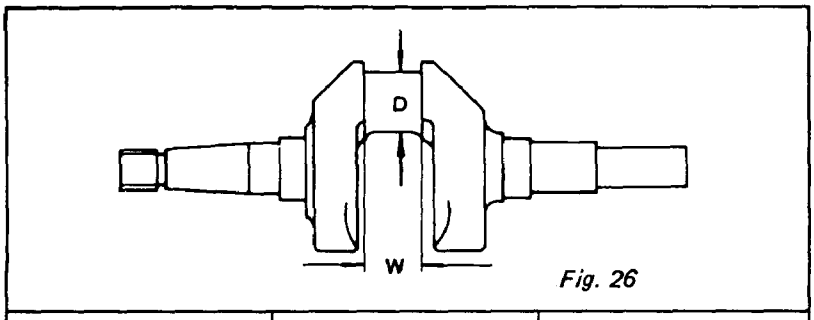


Fig. 26

		EY15	EY20	EY28
D (Crankshaft pin Dia.)		24 dia. $^{-0.037}_{-0.050}$	26 dia. $^{-0.037}_{-0.050}$	28 dia. $^{-0.020}_{-0.033}$
W (Crankshaft pin Width)		23 $^{+0.1}_{0}$	24 $^{+0.1}_{0}$	25 $^{+0.1}_{0}$
PISTON TO CYLINDER AT PISTON SKIRT THRUST FACE		0.020L ~ 0.059L		0.030L ~ 0.069L
PISTON RING GAP	TOP, SECOND	0.2L ~ 0.4L	0.05L ~ 0.25L	0.2L ~ 0.4L
	OIL	0.2L ~ 0.4L	0.05L ~ 0.25L	0.2L ~ 0.4L
PISTON RING SIDE CLEARANCE IN GROOVES	TOP RING	0.090L ~ 0.135L	0.050L ~ 0.095L	0.050L ~ 0.090L
	SECOND RING	0.060L ~ 0.105L	0.010L ~ 0.055L	0.030L ~ 0.070L
	OIL RING	0.010L ~ 0.065L	0.010L ~ 0.065L	0.010L ~ 0.065L
CONNECTING ROD TO CRANK PIN	DIA.	0.037L ~ 0.063L		0.020L ~ 0.046L
	SIDE	0.1L ~ 0.3L		
CONNECTING ROD TO PISTON PIN		0.010L ~ 0.029L		
PISTON PIN TO PISTON		0.009T ~ 0.010L		

L: LOOSE T: TIGHT

Table 1

5-4-2 CRANKSHAFT, CAMSHAFT, CHAIN and TAPPET (for EY15B)

1) Set the chain in the sprockets of the crankshaft and the chamshaft, as shown in Fig. 27.

   NOTE: Set the chain so that the white link plate matches to the timing marks of the crankshaft and the camshaft.

2) Put the tappets in the crankcase, and then set the crankshaft and the camshaft parallel. Then mount them onto the crankcase.

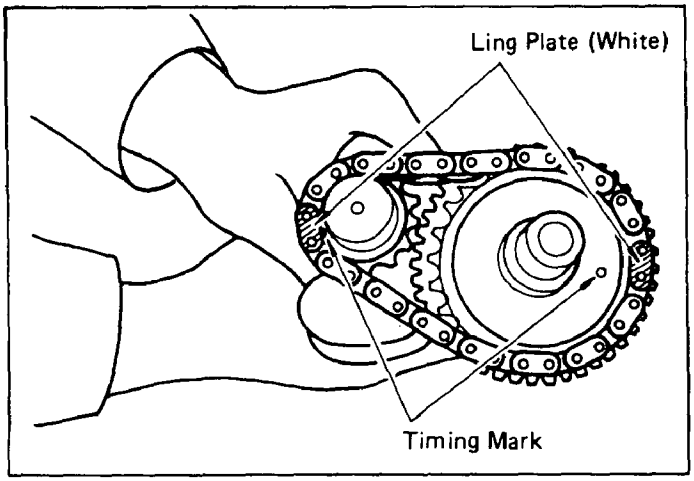


Fig. 27 (EY15B)

5-4-3 PISTON and PISTON RING

1) If no ring expander is available, install the rings by placing the open ring ends over the first land of the piston and spreading the rings only far enough to slip them over the correct ring grooves.

NOTE: Pay attention not to break the rings by twisting. Install the oil ring first followed by the second ring and then top ring. Meantime, the surfaces of the second ring and the top ring with carved marks are to be faced up.

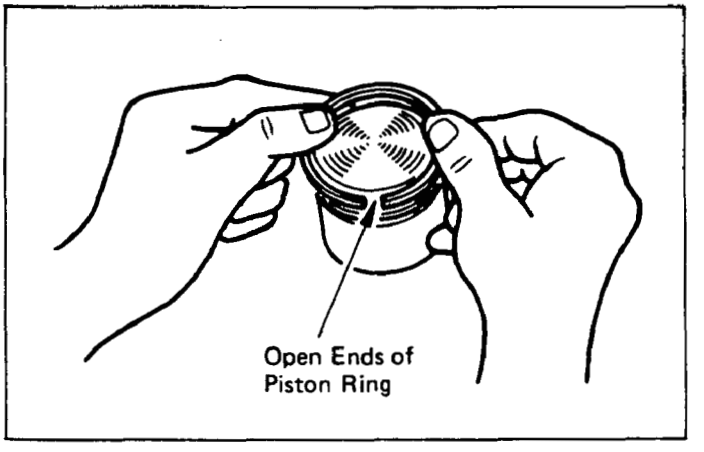
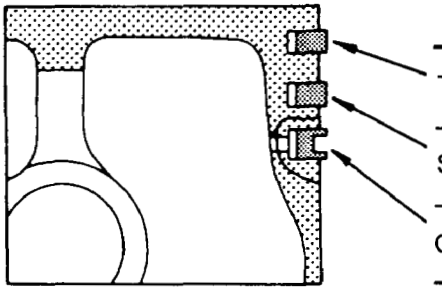


Fig. 28



	EY15, 20	EY28
Top Ring	Taper	Barrel Face
Second Ring	Taper Under Cut	
Oil Ring	Cutter Ring (without expander)	Cutter Ring (with expander)

Fig. 29

2) Reassemble the piston and connection rod by means of the piston pin.

NOTE: Apply enough oil to the small top end of the connecting rod.

Be sure to place the clips on both ends of the piston pin.

3) When installing the connecting rod into place, hold piston rings with the ring guide as shown in Fig. 30 (if no ring guide is available, keep pressing the piston rings with finger tips and gently strike the top of the piston with a wooden piece or the like to push it in), and check that the symbol ❼ or mark MA on the connecting rod is in the direction of the flywheel magneto.

NOTE: Apply enough oil to the piston rings, connecting rod plain bearings and cylinder wall before reassembling.

NOTE: The open ends of the piston rings must be 90° apart from one another on the piston periphery.

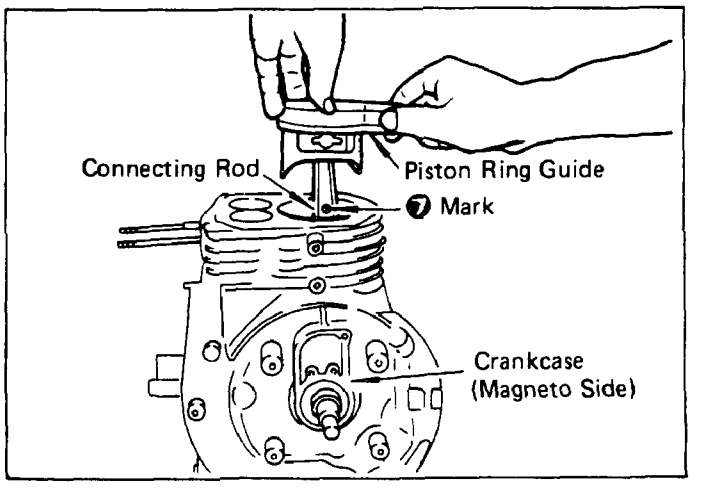


Fig. 30

NOTE: The clearance between the piston and cylinder must be measured at the piston skirt thrust surface.

5-4-4 CONNECTING ROD

1) Turn the crankshaft to the bottom dead center, lightly hammer the piston head until the connecting rod contacts the crankpin, and assemble.
2) When reassembling the connecting rod cap, match the alignment projection mark on the rod.
3) Oil scraper is to be set on the side of magneto. (See Fig. 31.)

NOTE: Use new lock washers, and bend the tabs securely.

NOTE: After reassembly, confirm that the connecting rod moves lightly.

NOTE: Connection rod cap tightening torque:

EY15 . . . . . 90 ~ 115 kg-cm

EY20, EY28 . . . . . 170 ~ 200 kg-cm

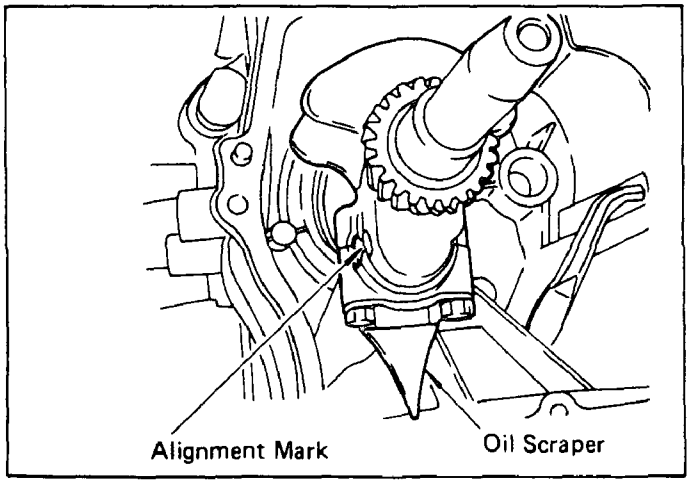


Fig. 31

NOTE: For the piston, piston ring and rod clearance, see Fig. 26.

5-4-5 TAPPET and CAMSHAFT

Insert the tappets back into their holes first, and then mount the camshaft.

NOTE: Align the timing mark at the root of a tooth of the cam gear with the one on the crank gear. If the valve timing is wrong, the engine cannot operate properly or at all. (See Fig. 32.)

In the EY15B, set the white link plate at the sprocket's timing mark. (See Fig. 27.)

NOTE: If the intake tappet and exhaust tappet were assembled contrarily each other, the tappet clearance cannot be kept correctly.

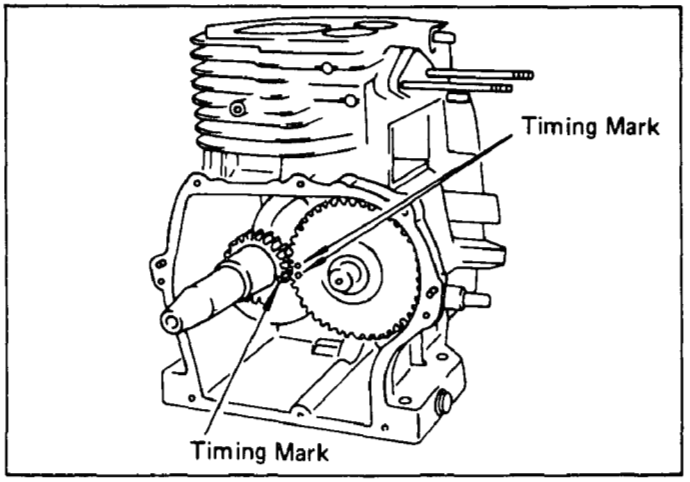


Fig. 32

5-4-6 MAIN BEARING COVER

Install the main bearing cover to the crankcase.

NOTE: When the chain guide is replaced in the EY15B, use the guide (chain guide) (See Fig. 33.), or set the chain so that the clearance between the chain and the chain guids is from 0 to 0.5mm. (See Fig. 34.)

NOTE: CHAIN GUIDE tightening torque 70 to 90 kg-cm.

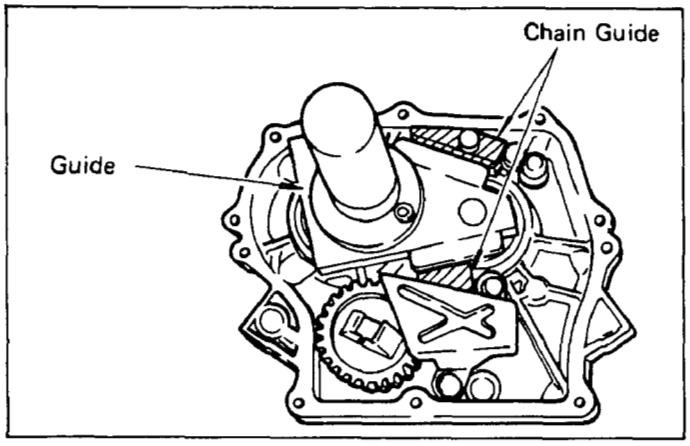


Fig. 33 (EY15B)

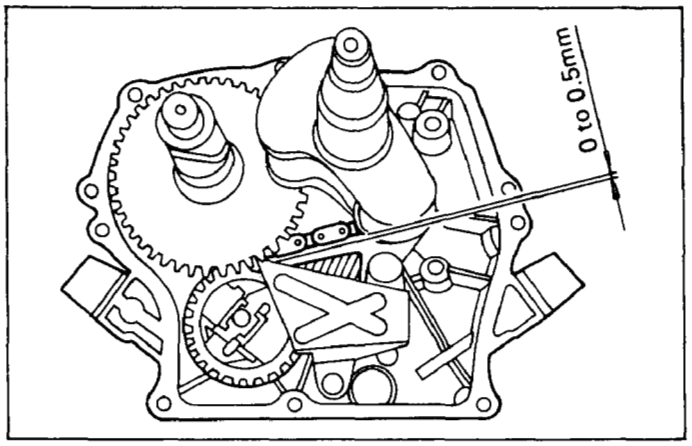


Fig. 34 (EY15B)

NOTE: As the governor gear is mounted on the main bearing cover side, install the main bearing cover while checking that it meshes with the teeth of the cam gear. (See Fig. 35.) Meantime, if the oil seal need be replaced, pressure-fit a new oil seal before installing the main bearing cover.

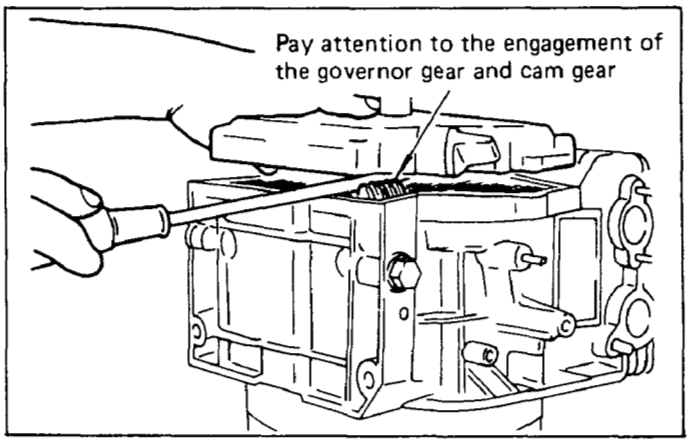


Fig. 35

NOTE: When installing main bearing cover, apply oil to the bearing and oil seal lip. Fit the oil seal guide over the crankshaft or camshaft to protect the oil seal lip from damage. Then place the main bearing cover on.

Check the crankshaft and camshaft their side clearance are 0 ~ 0.2 mm; and if not adjust them with the adjusting shims. (See Fig. 36.) (In D type, adjustment of the camshaft is not necessary)

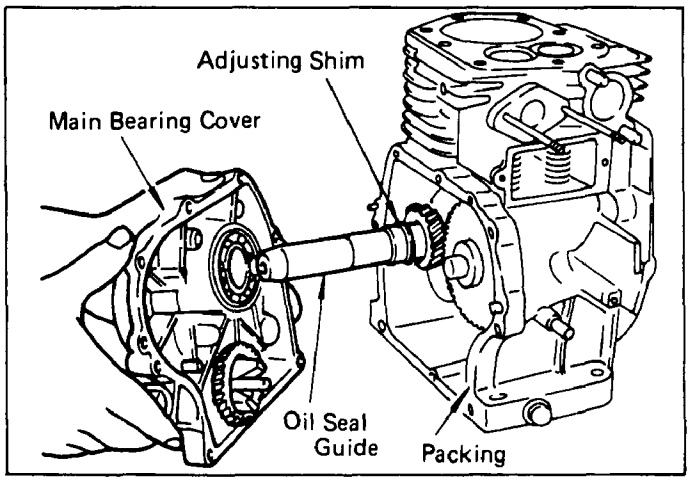


Fig. 36

NOTE: Main bearing cover tightening torque:

EY15, EY20 . . . . . 80 ~ 100 kg-cm
EY28 . . . . . 170 ~ 190 kg-cm

NOTE: Fig. 37 shows one of the methods measuring the crankshaft and camshaft side clearance between the machined face of the crankcase and adjusting collar. As a paper packing is used on the machined face of the crankcase, adjust the clearance by taking this thickness of 0.22 mm into account. (See Fig. 37.)

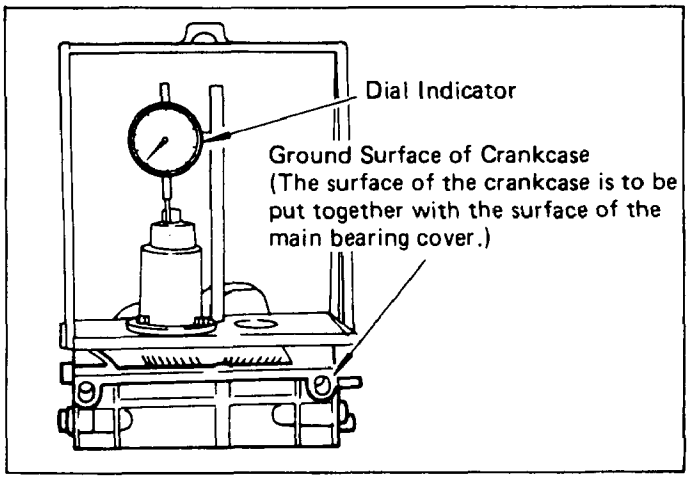

Dial Indicator
Ground Surface of Crankcase
(The surface of the crankcase is to be put together with the surface of the main bearing cover.)

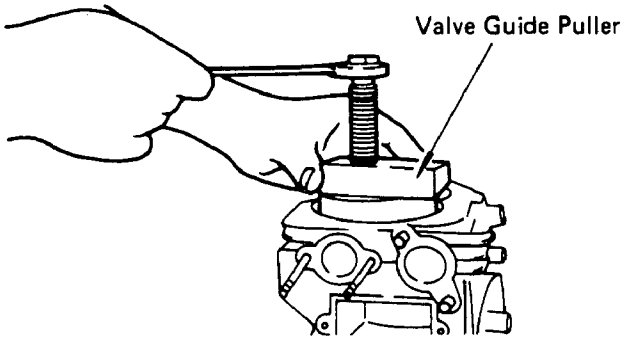
Fig. 37

5-4-7 INTAKE and EXHAUST VALVES

Remove carbon and gum deposite from the valves, valve seats, intake and exhaust ports and valve guides.

NOTE: If the valve face is dinted or warped, replace the valves with new ones.

NOTE: If there is an excessive clearance between the valve guide and valve stem, replace the valve guide with a spare. For replacing, pull out the valve guide, using the valve guide pulling base and bolts as shown in Fig. 38, and pressure-fit a new valve guide into place.



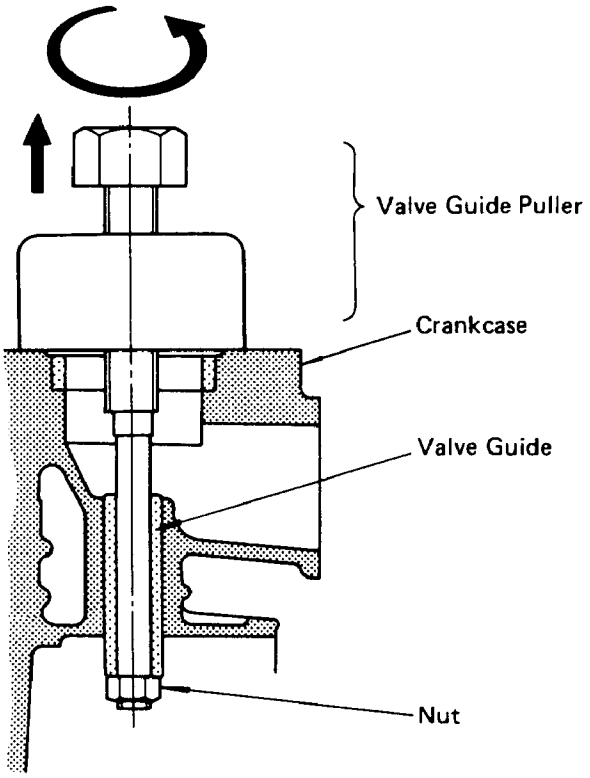


Fig. 38

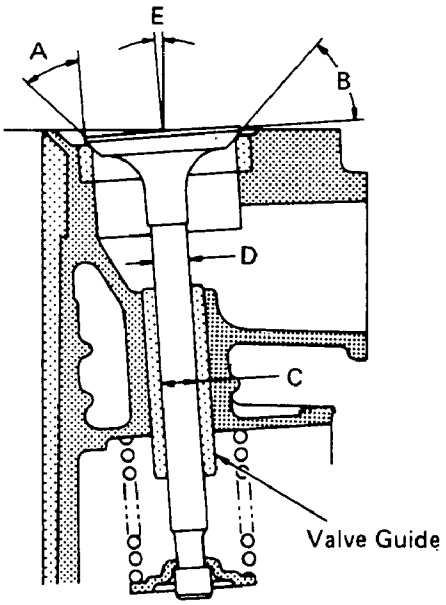


Fig. 39

VALVE and VALVE GUIDE CLEARANCE

		EY15	EY20	EY28
A-VALVE FACE ANGLE		45°		
B-SEAT ANGLE		45°		
C-GUIDE INSIDE DIA.		6.5 dia. $^{+0.022}_{0}$		
D-VALVE STEM OUTSIDE DIA.	INTAKE	6.5 dia. $^{-0.025}_{-0.040}$		
	EXHAUST	6.5 dia. $^{-0.056}_{-0.078}$		
MAXIMUM ALLOWABLE CLEARANCE BETWEEN C and D	INTAKE	0.025L ~ 0.062L		
	EXHAUST	0.056L ~ 0.100L		
E-VALVE STEM TILT ANGLE		3°53′		3°30′

L: LOOSE

Table 2

5-4-8 TAPPET ADJUSTMENT

Lower the tappet all the way down, push the valve, and insert a feeler gauge between the valve and tappet stem to measure the clearance. (See Fig. 40.)

NOTE: The correct tappet clearance for both intake and exhaust valves is **0.1 mm ± 0.02 mm** as measured when the engine is cold.

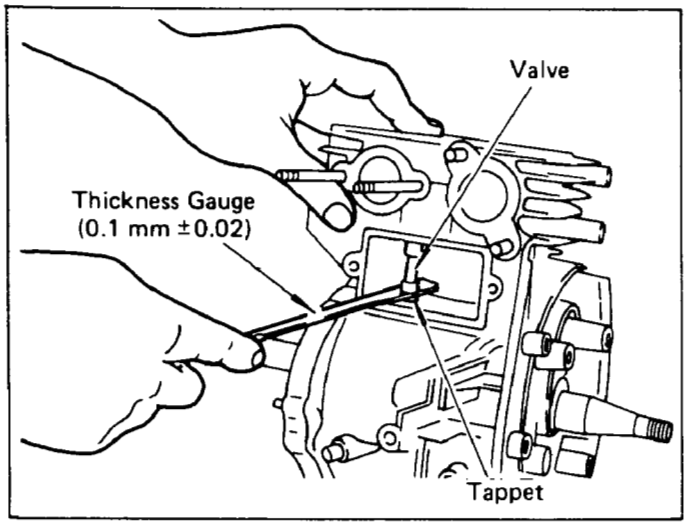


Fig. 40

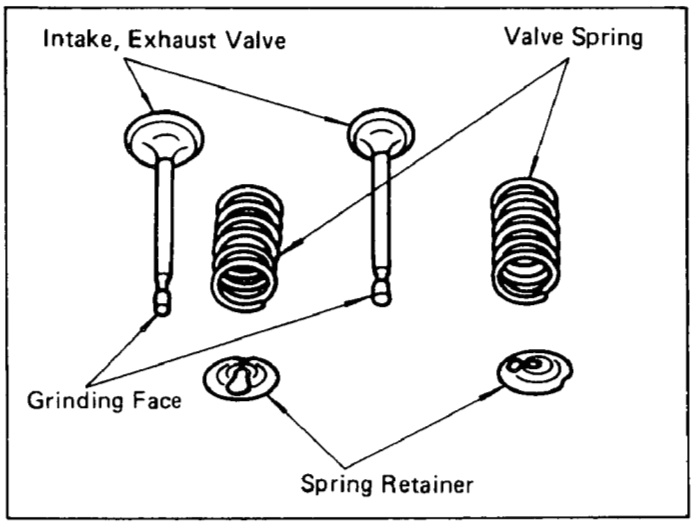


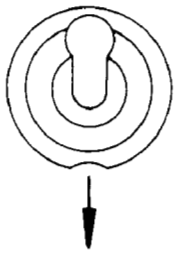
Fig. 41

NOTE: If the clearance is smaller than specified, slightly grind the top of the valve stem, and measure it again. On the contrary, if the clearance is too large, replace the valve with new one, and polish its contact surface with a compound to obtain a good fit. Then adjust the clearance.

NOTE: After the tappet clearance adjustment, install the valve spring retainers, and turn the crankshaft, and measure the tappet clearance once again if it is correct.

NOTE: INSTALLATION of SPRING RETAINERS

Place the notch on the outer circumference of the retainer toward this side and insert the retainer, like pushing in, using a special tool. (This special tool is used for EY18 and other models.) If a driver is used, insertion may be easier. (See Fig. 42.)



Front should be this side.

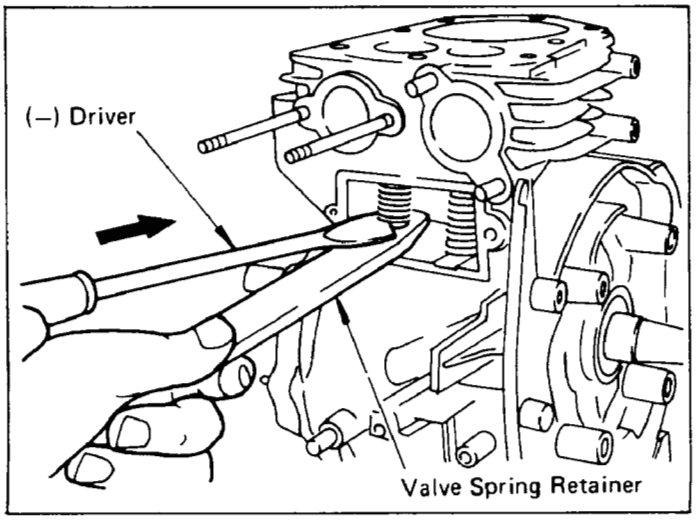


Fig. 42

5-4-9 CYLINDER HEAD

Remove carbon from the cylinder head, particularly its combustion chamber, and make clean the cooling fins. Also check the head for distortion.

NOTE: Replace the cylinder head gasket with a new one.

NOTE: DISTINGTION between the GASKET of EY15, EY20 and EY28

The pitch of the holes for the bolts fastening cylinder head and the outer circumference dimensions of the gasket for EY15 and EY20 are same. However, the inner dimensions are different each other. The gasket for EY15 has a red mark while the gasket for EY20 has a green mark.

For EY28, refer to Fig. 43.

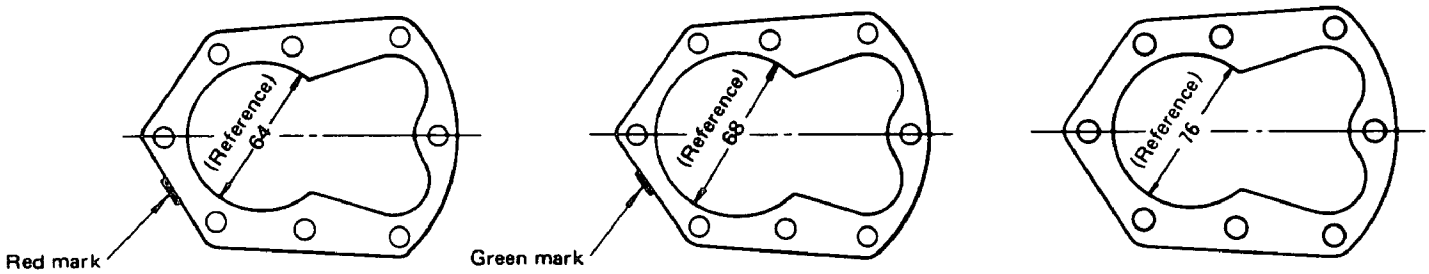


Fig. 43

NOTE: Cylinder head tightening torque: 190 ~ 230 kg-cm

NOTE: DISCRIMINATION of CYLINDER HEAD

As stated above, the pitch of the holes of cylinder head is common to both EY15 and EY20. For enabling to discriminate the cylinder head of EY15 from that of EY20, an embossed mark 15 is given to the former, while no embossed mark is given to the latter.

For EY28, an embossed mark "EY28" is given on the combustion chamber side of the cylinder head.

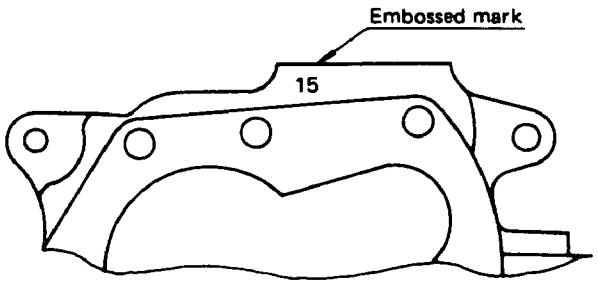


Fig. 44

NOTE: Meantime, embossed mark for-

EY15 Kerosene engine is 15K, and

EY20 Kerosene engine is 20K.

5-4-10 SPARK PLUG

Tightening torque of the spark plug:

EY15, EY20 . . . . . 120 ~ 150 kg-cm

EY28 . . . . . 230 ~ 250 kg-cm

5-4-11 IGNITION COIL, FLYWHEEL and STARTER PULLEY

1) Temporarily fasten the ignition coil to the crankcase, and install the flywheel to the crankshaft. Starting pulley is fastened together with the flywheel.

NOTE: Before installing, wipe out oil from the crankshaft and the tapered portion of the flywheel.

NOTE: Flywheel tightening torque: 600 ~ 650 kg-cm

2) After measuring the air gap between the ignition coil and flywheel, retighten the ignition coil. (See Fig. 45.)
Air gap: 0.5 mm

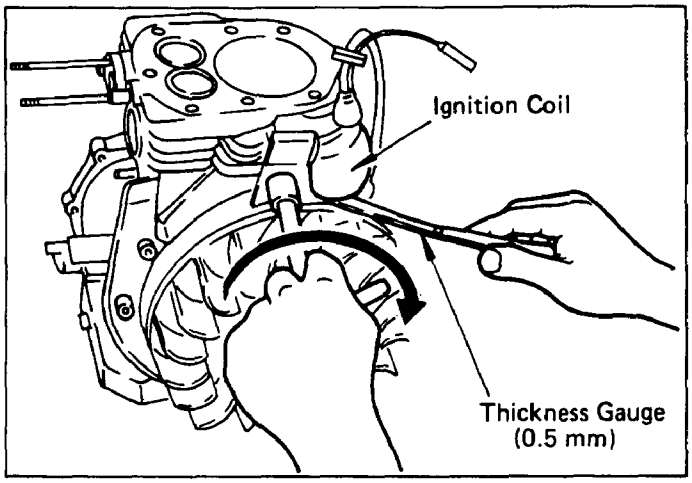


Fig. 45

5-4-12 CARBURETOR

To the cylinder portion of the crankcase install in the order of the gasket, insulator, gasket and carburetor, and then mount the air cleaner and fasten with two pieces of 6 mm nut.

5-4-13 GOVERNOR LEVER

When reassemblying, refer to the **7. GOVERNOR ADJUSTMENT**.

5-4-14 MUFFLER and MUFFLER COVER

With two pieces of the brass nut fasten the muffler to the crankcase and then install the muffler cover.

5-4-15 HEAD COVER, FUEL TANK and FAN COVER

Install in the order of the head cover, fuel tank and fan cover.

NOTE: If these items are installed in the order of the head cover, fan cover and fuel tank, removal of the fan cover would be impossible.

5-4-16 RECOIL STARTER

With 4 pieces of 6ϕ x 8 mm bolt fasten the recoil starter.

NOTE: It is feared that the bolt longer than 8 mm may damage the blades.

6. MAGNETO

6-1 MAGNETO

The spark for ignition is furnished by a magneto assembly. The magneto consists of a flywheel, ignition coil and contact breaker assembly (including condenser), of which flywheel is mounted on crankshaft and ignition coil contact breaker are mounted in crankcase directly. The EY15B type engine normally incorporates a solid state ignition system (T.I.C) described in 6-5.

6-2 BREAKER POINT ADJUSTMENT (Fig. 46)

The breaker points, which are mounted in the crankcase inside the flywheel should be checked twice a season or whenever the ignition spark becomes weak. If there is an evidence of pitting or pyramidding, the breaker points must be corrected, and then it becomes necessary to readjust the gap to its proper clearance.

The normal breaker point opening (point gap) is 0.35 mm at full separation. Since the spark timing of 23° is regulated by the point opening, use a timing light to obtain an accurate spark advance. (Refer to "6-3 TIMING ADJUSTMENT.")

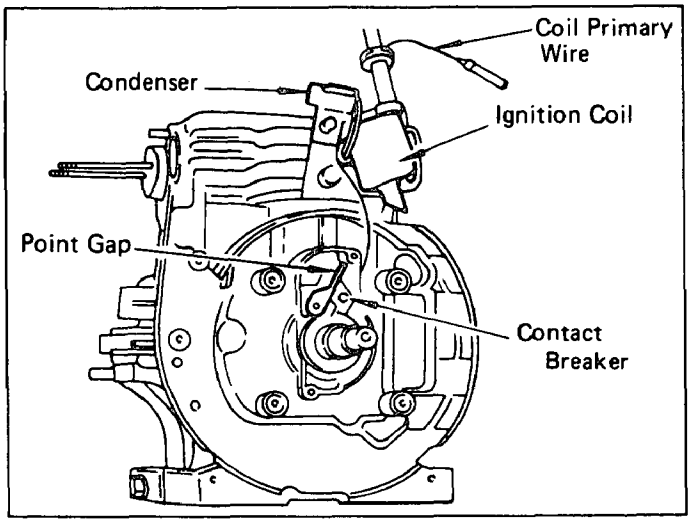


Fig. 46

To adjust breaker point opening, remove starting pulley, blower housing and flywheel from the engine and proceed as follows: (See Fig. 46.)

1) Remove breaker cover from contact breaker.
2) Turn crankshaft over until breaker arm comes in contact with the high point of the breaker cam. (Maximum point opening of 0.35 mm)
3) Loosen contact support plate lock screw just enough so that bracket can be moved.
4) Insert a 0.35 mm feeler gauge between the points.

CAUTION: Adjust breaker point gap without opening it more than 2 mm, otherwise rated heel-pressing force may not be obtained due to the bending of contact breaker arm.

5) Apply a screw driver to adjusting tab and move the contact support plate just enough so that a slight drag is felt while sliding the feeler gauge from between the points.
6) Tighten lock screw and recheck breaker point gap.
7) Pull a strip of 8 ~ 10 mm wide white paper through the closed points to remove oil and dust on the point surfaces.

CAUTION: When inserting a sheet of paper, never open the breaker point gap more than 2 mm.

8) Mount flywheel, blower housing and starting pulley on engine after adjustment.

6-3 TIMING ADJUSTMENT (See Figs. 47, 48 and 49)

The spark is timed to occur at 23° before the piston reaches TDC on the compression stroke. This spark advance of 23° is controlled by the breaker point opening and this advance is obtained when the breaker point opening is adjusted according to the BREAKER POINT ADJUSTMENT to its proper point opening. However, the advance timing is more accurately adjusted through the following procedures using a timing tester as shown in Fig. 48.

NOTE: Refer to section "4-11 IGNITION" and "13. CHECKS and CORRECTIONS."

6-3-1 ALIGNMENT MARK for TIMING ADJUSTMENT

(See Fig. 47.)

For timing adjustment, the following alignment marks are provided as shown in Fig. 47.

* "M" mark and line on the crankcase
* "P" mark and line on the flywheel cooling fan

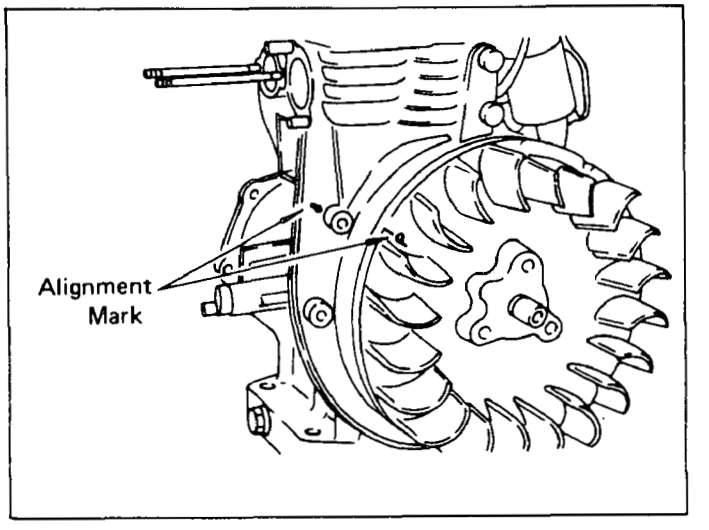


Fig. 47

6-3-2 TIMING ADJUSTMENT with TIMING TESTER

1) Disconnect the stop button lead wires and the coil primary wire.
2) Remove blower housing from engine.
3) Connect the timing tester lead with red rubber cap to the coil primary wire and ground the lead with black rubber cap to the crankcase. (See Fig. 48.)
   While the points are open, the buzzer within tester remains ringing and when the points are closed, the tester remains silent. (See Fig. 48.)
4) Turn the flywheel slowly until alignment mark on the flywheel is in the line with alignment mark on the carankcase.

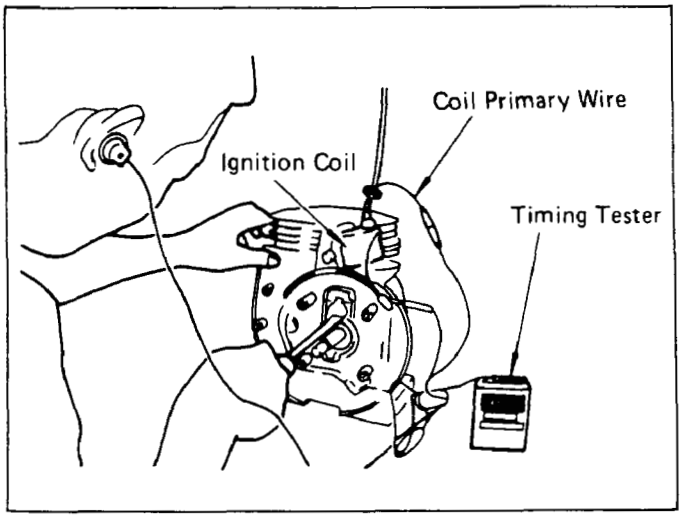


Fig. 48

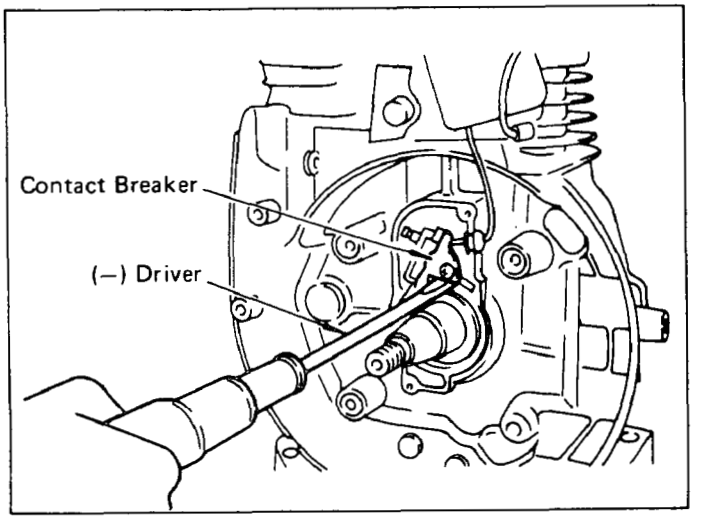


Fig. 49

5) Remove the flywheel without turning crankshaft at all.
6) Loosen the lock screw of the breaker point support plate so that the breaker point can be rotated.
7) By rotating the support plate of the breaker point, find the exact point when the buzzer within timing tester starts ringing from being silent. (See Figs. 48 and 49.)
8) Put the flywheel back and check by rotating flywheel slowly. If the buzzer in timing tester starts ringing when line mark on the flywheel is in the line with line mark on the crankcase. When the line marks are in alignment, the timing is correct.
9) If the timing mark lines are not in alignmnent, then readjust the point opening according to the BREAKER POINT ADJUSTMENT, by removing the flywheel and repeat the checking procedure 3) through 5).
10) After completing the timing adjustment remount the blower housing and connect the coil primary lead to the stop button.

6-4 MAGNETO TROUBLE SHOOTING

When the engine does not start or starts with difficulty, or when its operation is unstable, the following tests will clarify if they are caused by a defect in the magneto.

1) Check igntion cable for possible corrosion, broken, worn insulator or loose connection.
2) Check the sparking as described later in this section.
3) Check if the breaker points require cleaning, or adjusting or not. If the points are badly corroded or pitted, condenser may have to be replaced too.
   Refer to "BREAKER POINT ADJUSTMENT."
4) If no spark takes place, replace igntiion coil.

***SPARK TESTING**

Remove spark plug from cylinder head and place it on blower housing, with the ignition cable connected to it.
Crank the engine several times by starting pulley and observe the spark in the spark gap of spark plug. If the spark is strong, the ignition system can be eliminated as the source of trouble.
If the spark is weak or there is no spark at all, repeat the checks according to the procedures 1) through 3) above.
The correct electrode gap is 0.6 ~ 0.7 mm. (Refer to section **"15. CHECKS and CORRECTIONS."**)

6-5 SOLID STATE IGNITION (See Section 10 "ROBIN SOLID STATE IGNITION ENGINE" for details.)

The following solid state ignition systems are available as optional or standard:

1) T.I.C. (TRANSISTOR IGNITION CIRCUIT) (EY15, EY20, EY28)
   On the outside of the flywheel, an igntiion coil is installed, which is so-called outer coil type. This is equipped to the standard type engine, and the exciter coil (primary-excitation) is available as an optional part. (The flywheel is for common use.) (See Fig. 59.)
2) P.I.T. (PULSER IGNITION TRANSISTOR) (EY15, EY20)
   The ignition coil and lighting coil are installed inside the flywheeel. This built-in type ignition system is installed to the engine in which lighting coil is requested. (P.I.T. unit is installed on the outside of the flywheel.)

7. GOVERNER ADJUSTMENT

Models EY15, EY20 and EY28 employ a centrifugal flyweight type governor. The governor is mounted on the governor gear and the throttle valve of the carburetor is automatically regulated by a lever which is connected to the governor in order to maintain constant engine speed against load variations.

The adjustment procedure of the governor is as follows (See Figs. 50 and 51.):

1) Connect the carburetor throttle lever to the governor lever with the connecting link, and mount them onto the governor shaft.
2) Install the speed control lever to the cylinder head.
3) Connect the governor lever to the control lever with the governor spring.

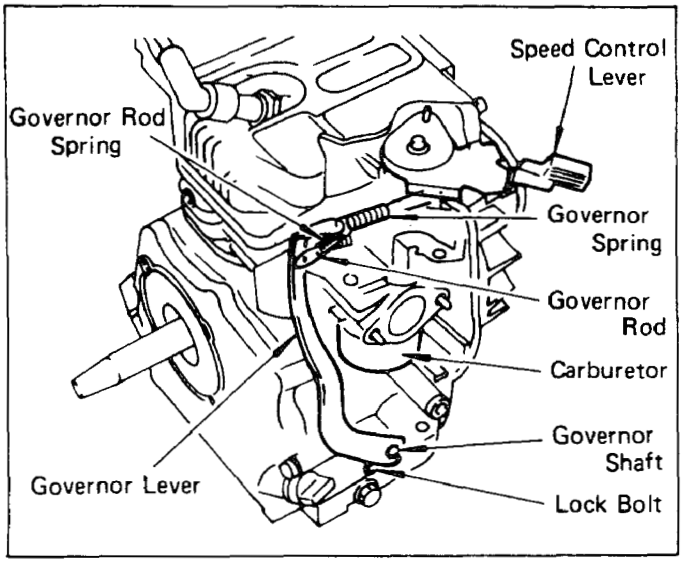


Fig. 50

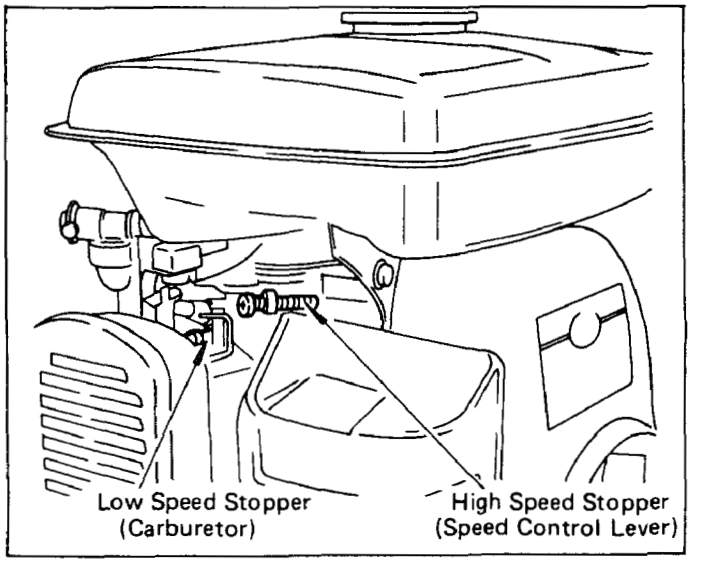
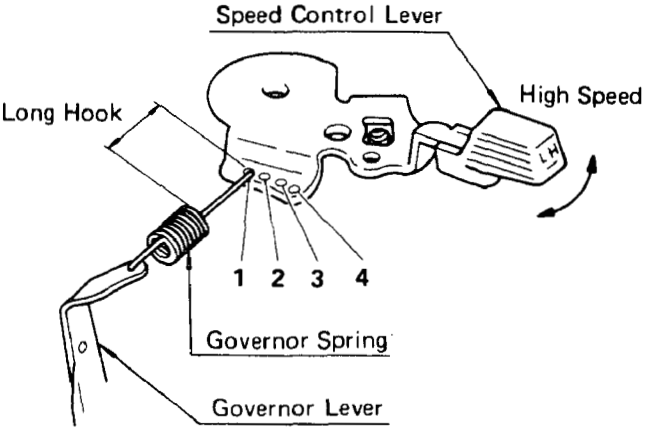


Fig. 51

***The point where the governor spring is to be hooked**

For EY15 and EY28 the governor spring is to be hooked at the point **1**, while it is to be hooked at the point **2** for EY20.

4) Turn the control lever towards high speed, and confirm that the carburetor throttle valve is fully opened. Control lever can stay wherever it is required.



An example of the governor spring being hooked

Fig. 52

5) With a screwdriver in the groove of the governor shaft, turn it "clockwise" fully until the governor shaft no longer moves, and then lock the governor lever to the governor shaft with the governor lever tightening bolt. (See Fig. 53.)

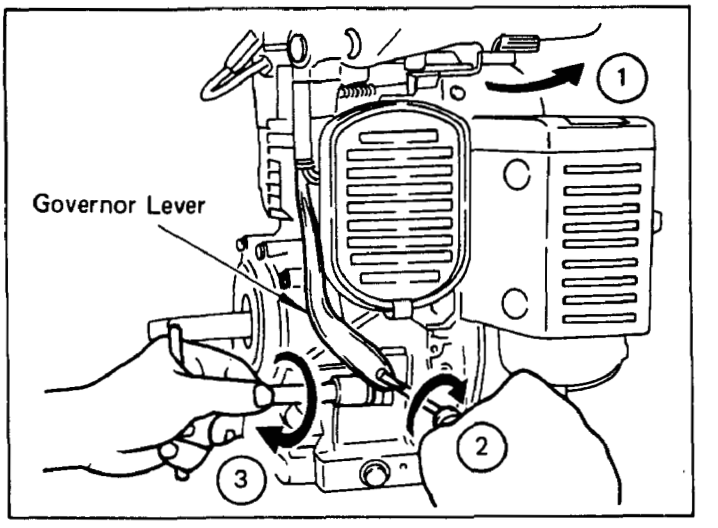


Fig. 53

*Dimensions of the governor spring for the engine to be connected to the generator:

Both EY15 and EY20 engines can be connected to the generators of both 50Hz and 60Hz; and the dimensions of the governor spring to be hooked are different each other according to the hertz. Meantime, the dimensions of the governor spring for the standard engine is same as those of the spring for the engine to be connected to the 60Hz generator.

EY28 engine can be connected to the generators of both 50 Hz and 60 Hz; but it is necessary to select the right engine to the right generator. Meantime, standard type engine is for the 60 Hz generator.

Discrimination according to the dimensions:

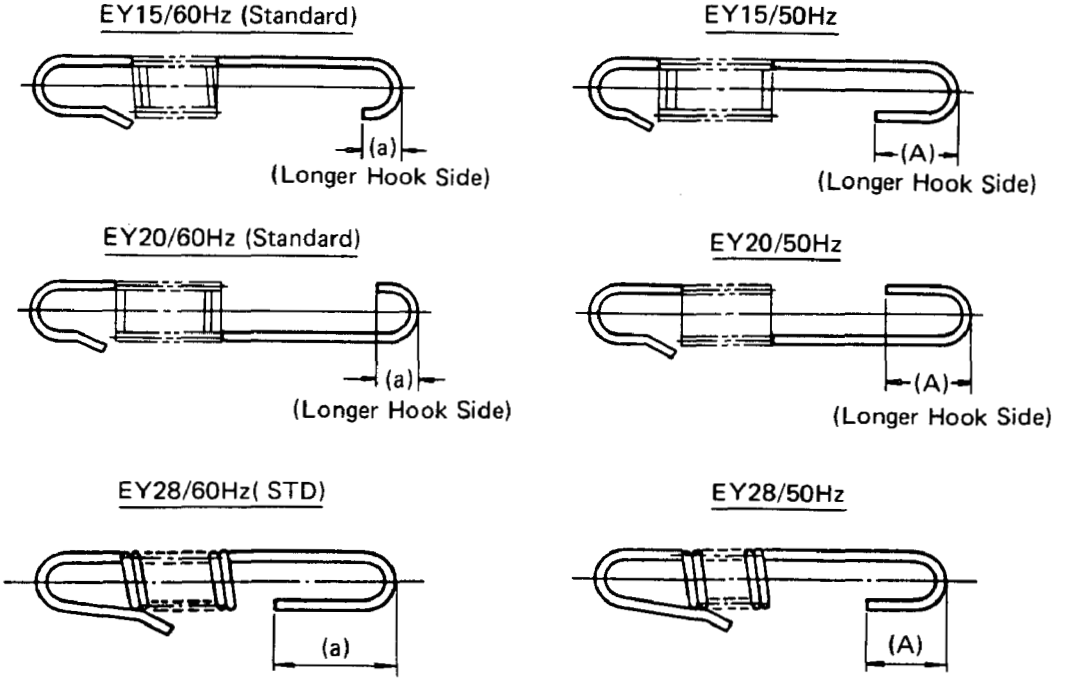


Fig. 54

*For EY15, EY20 and EY28 it is commonly said that the governor spring longer in the length of (A) is for 50 Hz.

*Both ends of the spring for EY15 are bended to the same direction, while both ends of the spring for EY20 are bended to contrary directions.

8. CARBURETOR

8-1 OPERATION and CONSTRUCTION (See Fig. 55 and Fig. 56.)

8-1-1 FLOAT SYSTEM

The float chamber is located just below the carburetor body and, with a float and a needle valve, maintains a constant fuel level during engine operation.

The fuel flows from the fuel tank into the float chamber through the needle valve. When the fuel rises to a specific level, the float rises; and when its buoyancy and fuel pressure are balanced, the needle valve close to the shut off the fuel, thereby keeping the fuel at the reference level.

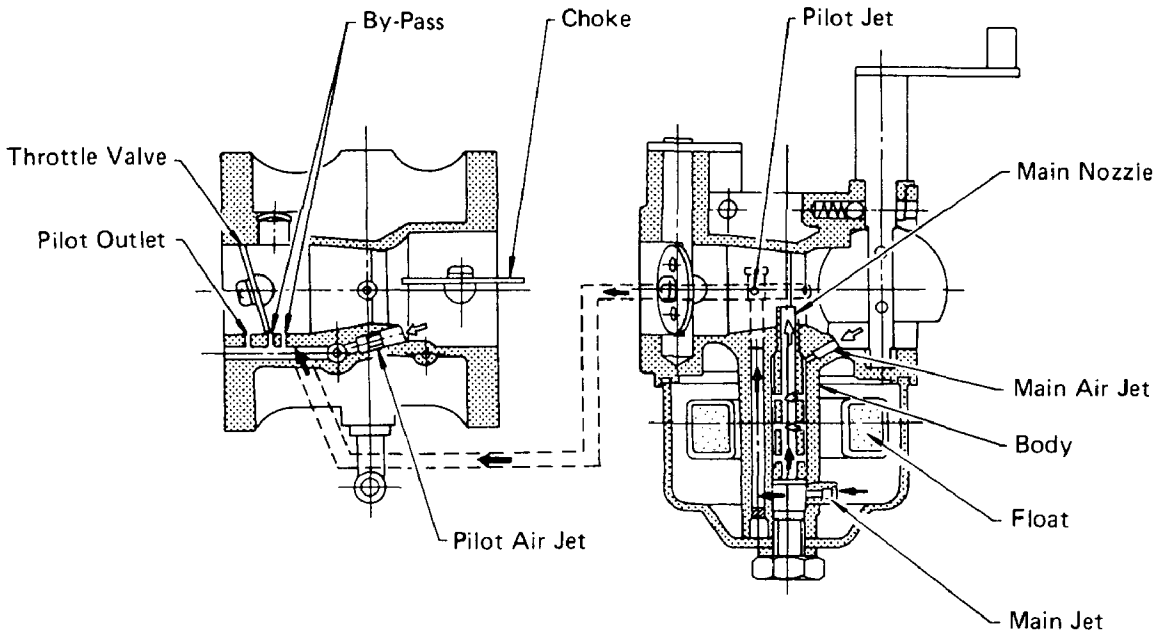


Fig. 55

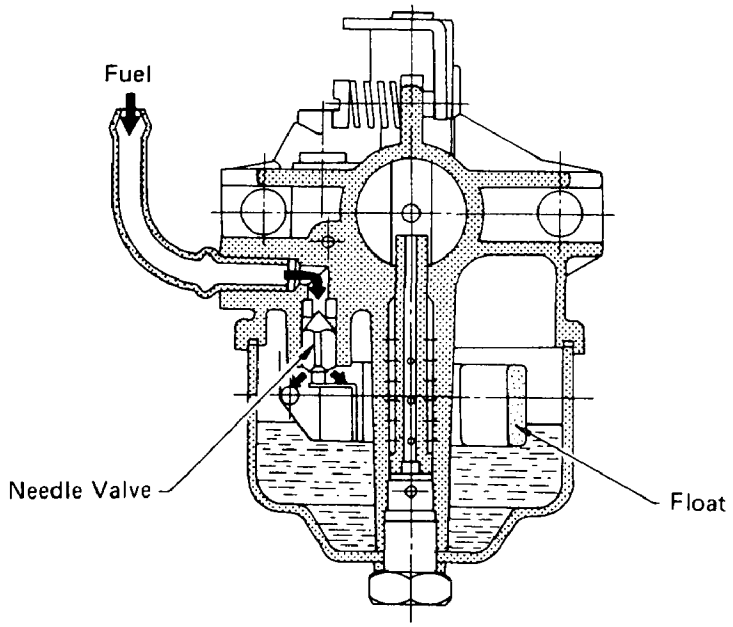


Fig. 56

8-1-2 PILOT SYSTEM

The pilot system feeds the fuel to the engine during idling and low-speed operation.

The fuel is fed through the main jet to the pilot jet, where it is metered, and mixed with the air metered by the pilot air jet.

The fuel-air mixture is fed to the engine through the pilot outlet and the by-pass.

During engine idling, the fuel is mainly fed from the pilot outlet.

8-1-3 MAIN SYSTEM

The main system feeds the fuel to the engine during medium- and high-speed operation.

The fuel is metered by the main jet and fed to the main nozzle. The air metered by the main air jet is mixed with the fuel through the bleed holes in the main nozzle, and the mixture is atomized out of the main bore. It is mixed again with the air taken through the air cleaner into an optimum fuel-air mixture, which is supplied to the engine.

8-1-4 CHOKE

The choke is used for easy start in the cold season. When the recoil starter is pulled with a closed choke, the negative pressure applied to the main nozzle increases and draws much fuel accordingly; thus easily start up the engine.

8-2 DISASSEMBLY and REASSEMBLY

Apart from mechanical failures, most of carburetor troubles are caused by an incorrect mixing ratio, which may arise mainly due to a clogged up air or fuel passage in jets, or fuel level variations. In order to assure proper flow of air and fuel, the carburetor must be kept clean at all times. The carburetor disassembly and reassembly procedures are as follows:

(See Figs. 57 and 58.)

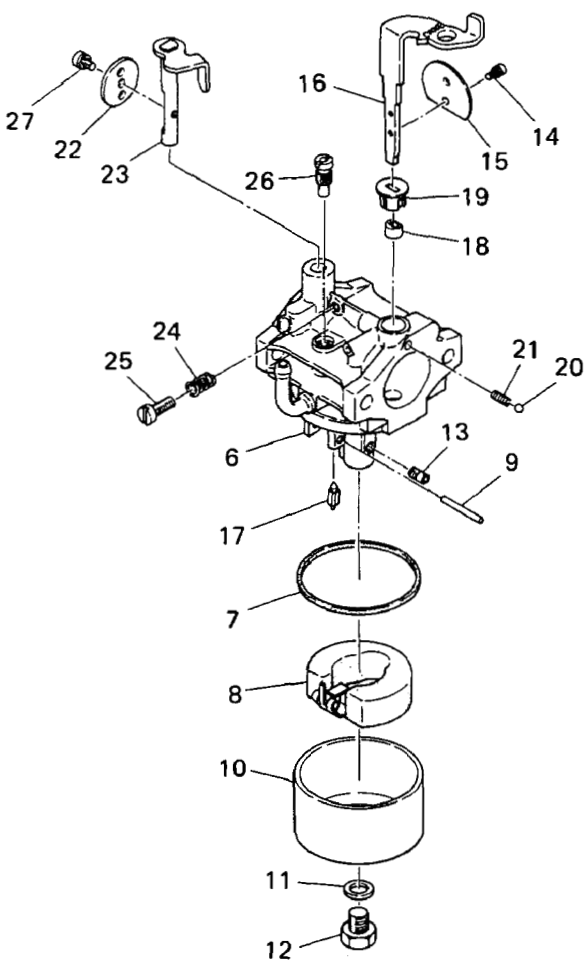


Fig. 57 (EY15, 20)

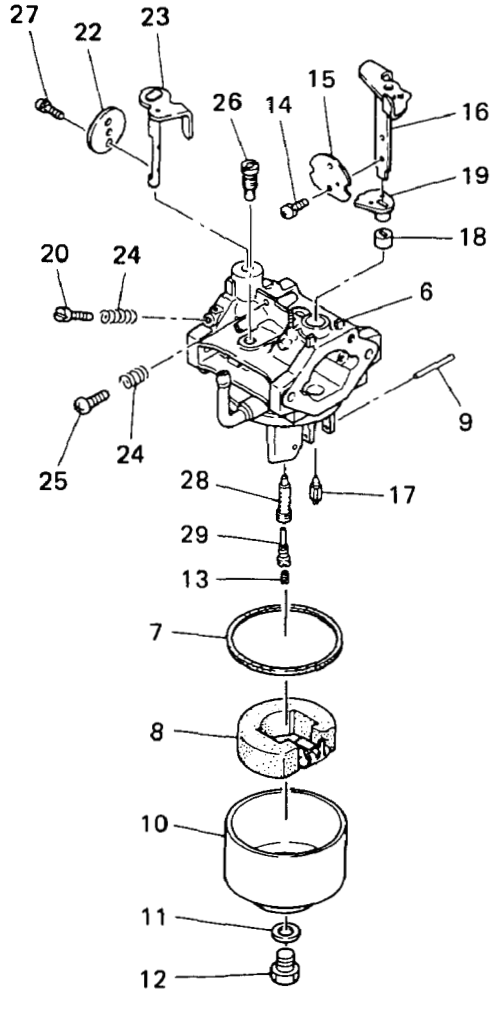


Fig. 58 (EY28)

8-2-1 THROTTLE SYSTEM

1) Remove the Philips screw (27) and throttle valve (22), and pull out the throttle shaft (23).
2) The spring (24) can be taken out by removing the throttle stop screw (25).

*Exercise care not to damage throttle valve ends.

8-2-2 CHOKE SYSTEM

1) Remove the Philips screw (14) and choke valve (15), and pull out the choke shaft (16).
2) When reassembling the choke shaft, make sure that the cutout in the choke valve faces the main air jet.
   Meantime, when reassembling the moderation regulating ball (20) and the spring (21), set these parts at the right positions with the rings (18) and (19) and then reassemble.

8-2-3 PILOT SYSTEM

1) Remove the pilot jet (26), using correct tool to avoid damage to it.
2) Reassembly
   Tighten the pilot jet securely. Otherwise, the fuel may leak, causing engine malfunction.

8-2-4 MAIN SYSTEM

1) Remove the bolt (12) and take out float chamber body (10).
2) Remove the main jet (13) from the body (6). [In case of EY28, remove the main jet (13) from the pipe assy (29), and then remove the pipe assy (29) and the nozzle (28) from the carburetor body (6).]
3) Reassembly
   a) Fasten the main jet securely to the body. Otherwise, the fuel may become too rich and cause engine malfunction.
   b) The bolt tightening torque is 70 kg-cm.

8-2-5 FLOAT SYSTEM

1) Pull out the float pin (9) and remove the float (8) and needle valve (17). If the needle valve need be replaced, replace it with rubber needle.
   CAUTION: When cleaning the jets, use neither a drill nor a wire (because of possible damage of the orifice which will adversely affect fuel flow). Be sure to use compressed air to blow them clean.
2) When removing the needle valve and floats, gently tap the reverse side using the rod more slender than the float pin and remove because the float pin is calked to the carburetor body.

9. BREAK-IN OPERATION of REASSEMBLED ENGINE

An overhauled engine must be operated at low speed break-in the parts. A thorough break-in is indispensable particularly when the cylinder, piston, piston rings or valves are replaced with new ones.

The recommended break-in schedule is shown below.

LOAD			SPEED (CRANKSHAFT REV.)	TIME
EY15	EY20	EY28		
NO LOAD			2,500 rpm	10 minutes
NO LOAD			3,000 rpm	10 minutes
NO LOAD			3,600 rpm	10 minutes
1.35 HP	1.75 HP	2.75 HP	3,600 rpm	30 minutes
2.7 HP	3.5 HP	5.5 HP	3,600 rpm	60 minutes

10. ROBIN SOLID STATE IGNITION ENGINE (T.I.C. and P.I.T.)

10-1 FEATURES

Model EY15D and EY20D can employ as option a pointless ignition system, called Solid State Ignition, which is the circuit breaker type ignition device, utilizing the power transistor as an element for controling electric current. There are two types of this system, the one is outer coil type without pulser and is called T.I.C. (Transistor ignition circuit type) and the other type has a built-in pulser coil and is called P.I.T. (Pulser transistor type). T.I.C. is a standard ignition system for EY28D, B. Being different from the breaker point type ignition system, this brand-new system is completely free from such troubles as starting-up failure owing to dirty, burnt or oxidized point surface, lowering of ignition efficiency being caused by moisture, rough surface of breaker point and incorrect timing resultant from worn mechanical parts.

10-2 BASIC THEORY of T.I.C. (See Fig. 59.)

T.I.C. (Transistor ignition type) consists of the flywheel and ignition coil with built-in transistor; and its basic theory is as follows:

1) Revolution of the flywheel generates electricity on the primary side of the ignition coil, and the electric current **A** runs. **A** makes the power transistor "ON" and the electric current **B** passes.
2) The flywheel goes round further, and at the time of ignition the electric current **C** runs, then the electric current **D** runs to the signal transistor, by which the electric current **B**, passing through the power transistor, is abruptly cut; and as a result, the high voltage electricity is generated on the secondary side of the ignition coil and it sparks at the plug.

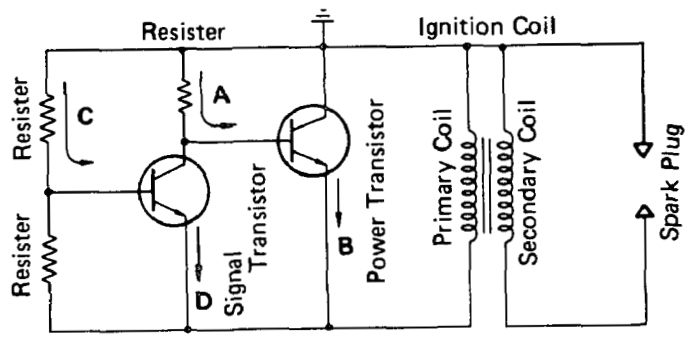


Fig. 59

10-3 BASIC THEORY of P.I.T. (See Fig. 60.)

P.I.T (Pulser ignition transistor type) consists of the ignition coil, P.I.T. unit and flywheel; and its basic theory is as follows:

1) Revolution of the flywheel generates electricity on the primary side of the ignition coil, and the electric current **A** runs. **A** makes the power transistor "ON" and the electric current **B** passes.
2) The flywheel goes round further, and at the time of ignition, the pulser coil generates electricity, and the electric current **C** runs; and SCR becomes "ON." Then, the electric current **D** runs, by which the electric current **B** is cut abruptly, and as a result the high voltage electricity is generated on the secondary side of the ignition coil and it sparks at the plug.

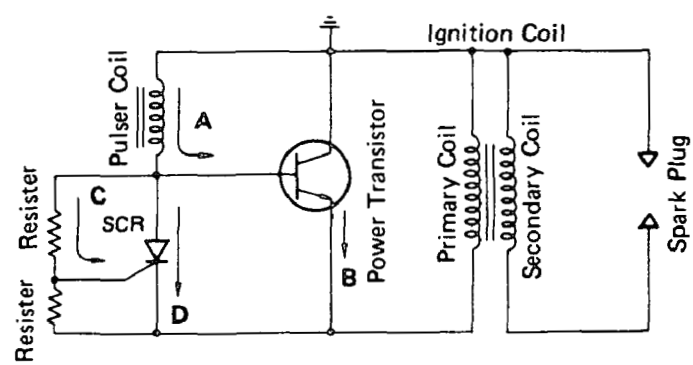


Fig. 60

11. TROUBLE SHOOTING

The following three conditions must be satisfied for satisfactory engine start.

1. The cylinder filled with a proper fuel-air mixture.
2. An appropriate compression in the cylinder.
3. Good sparks at the correct time to ignite the mixture.

The engine cannot be started unless these three conditions are met. There are also other factors which make engine start difficult, e. g., a heavy load on the engine when it is about to start at low speed, and a high back pressure due to a long exhaust pipe, just to say a few.

The most common causes of engine troubles are given below:

11-1 STARTING DIFFICULTIES

11-1-1 FUEL SYSTEM

1) No gasoline in th fuel tank; or the fuel cock is closed.
2) The carburetor is not choked enough, particularly when the engine is cold.
3) Water, dust or gum in the gasoline block flow of the fuel to the carburetor.
4) Inferior grade gasoline or poor quality gasoline is not gasfied enough to produce the correct fuel-air mixture.
5) The carburetor needle valve is held open by dirt or gum. This trouble can be detected as the fuel flows out of the carburetor when the engine is idling. (Overflow)
   This trouble may be remedied, depending on cases, by lightly tapping the float chamber with the grip of a screwdriver of the like.
6) If the carburetor overflows, excessive fuel runs into the cylinder when starting the engine, making the fuel-air mixture too rich to burn. If this happens, remove the spark plug, and turn the starting pulley a few turns in order to let the rich fuel-air mixture out of the spark plug hole into the atmosphere. Keep the carburetor choke open during this operation. Dry the spark plug well, screw it into place, and try to start again.
7) When the engine is cold, pull the carburetor knob to let the gasoline flow into the carburetor.

11-1-2 COMPRESSION SYSTEM

If starting difficulties and loss of power are not due to the fuel system or ignition system, the following must be checked for possible lack of compression.

1) Engine inside is completely dried up because of a long period of non-operation.
2) Loose or broken spark plug. This causes a hissing noise made by mixture gas running out of cylinder in compression stroke during cranking.
3) Damaged head gasket or loose cylinder head. A similar hissing noise is produced during compression stroke.
4) Incorrect Tappet Clearance
   If the correct compression is not obtained even after remedying the above, disassemble the engine and check further as follows:
   a) Valve stuck open due to carbon or gum on the valve stem.
   b) If the piston rings are stuck on the piston, remove the piston and connecting rod from the engine, and clean, remedy or replace the parts.

11-1-3 ELECTRICAL SYSTEM

Check the following for lack of sparks.

1) Leads of the ignition coil, spark plug or contact breaker disconnected.
2) Ignition coil damaged and shorted.
3) Spark plug cable wet or soaked with oil.
4) Spark plug dirty or wet.
5) Spark plug electrode gap incorrect.
6) Spark plug electrodes in contact with each other.
7) Contact breaker points pitted or fused.
8) Breaker arm stuck.
9) Condenser leaking or grounded.
10) Incorrect spark timing.

11-2 ENGINE MISFIRES

1) Incorrect spark plug electrode gap. Adjust it to anywhere between 0.6 and 0.7 mm.
2) Ignition cable worn and leaking.
3) Sparks weak.
4) Ignition wire connections loose.
5) Pitted or worn breaker points.
6) Water in gasoline.
7) Insufficient compression.

11-3 ENGINE STOPS

1) Fuel tank empty. Water, dirt, gum, etc. in gasoline.
2) Vapor lock, i. e., gasoline evaporating in the fuel lines due to overheat around the engine.
3) Vapor lock in the fuel lines or carburetor due to the use of too volatile winter gas in the hot season.
4) Air vent hole in the fuel tank cap plugged.
5) Bearing parts seized due to lack of oil.
6) Magneto or ignition coil faulty.

11-4 ENGINE OVERHEAT

1) Crankcase oil level low. Add oil immediately.
2) Spark timing incorrect.
3) Low grade gasoline is used, or engine is overloaded.
4) Cooling air circulation restricted.
5) Cooling air party misdirected causes loss of cooling efficiency.
6) Cylinder head cooling fins clogged up with dirt.
7) Engine operated in an enclosed space without fresh supply of cooling air.
8) Exhaust gas discharge restricted, or carbon deposits in the combustion chamber.
9) Engine running on low-octane gasoline detonates due to heavy load at low speed.

11-5 ENGINE KNOCKS

1) Low-quality gasoline.
2) Engine operating under heavy load at low speed.
3) Carbon or lead deposits in the cylinder head.
4) Spark timing incorrect.
5) Loose connecting rod bearing due to wear.
6) Loose piston pin due to wear.
7) Causes of engine overheat.

11-6 ENGINE BACKFIRES through CARBURETOR

1) Water or dirt in gasoline, or low-grade gasoline.
2) Intake valve stuck.
3) Valves overheated, or red-hot carbon particles in the combustion chamber.
4) Engine cold.

12. INSTALLATION

Engine life, ease of maintenance and inspection, frequency of checks and repairs, and operating cost all depend on the way in which the engine is installed. Carefully observe the following instructions for installing the engine.

12-1 INSTALLING

When mounting the engine, carefully examine its position, the method of connecting it to a load (machine), the foundation, and the method of supporting the engine.

When determining its mounting position, in particular, make sure that gasoline and oil can easily be supplied and checked, the spark plug and breaker can easily be checked, the air cleaner can easily be serviced, and that the oil can easily be discharged.

12-2 VENTILATION

Fresh air is necessary for cooling the engine and burning the fuel.

In cases where the engine is operated under a hood or in a small room, temperature rise in the engine room can cause vapor lock, oil deterioration, increased oil consumption, loss of power, piston seizure, shorter engine life, etc., making it impossible to operate the engine properly. It is necessary, therefore, to provide a duct or baffle to guide cooling air to the engine to prevent recirculation of the hot air used for engine cooling, and temperature rise of the load (machine).

Take steps as necessary to keep the engine room temperature below 50°C even in the hottest period of the year.

12-3 EXHAUST GAS DISCHARGE

Exhaust gas is noxious. When operating the engine indoors, be sure to discharge the exhaust gas outdoors. If a long exhaust pipe is used in such a case, the internal resistance increases causing loss of engine power. Thus pipe inside diameter must increase in proportion to exhaust pipe length.

Exhaust pipe: Less than 3 m long, pipe inside diameter 25 mm,
Less than 5 m long, pipe inside diameter 30 mm.

12-4 POWER TRANSMISSION to DRIVEN MACHINES

12-4-1 BELT DRIVE

Take the following notes into consideration.

* V-belts are preferable to flat belts.
* The driving shaft of the engine must be parallel to the driven shaft of the load.
* The driving pulley of the engine must be in line with the driven pulley of the load.
* Install the engine pulley as close to the engine as possible.
* If possible, span the belt horizontally.
* Disengage the load when starting the engine.

If no clutch is used, use a belt tension pulley or the like.

12-4-2 FLEXIBLE COUPLING

When using a flexible coupling, runout and misalignment between the driven shaft and engine shaft must be minimized. Runout and misalignment tolerance are specified by the coupling manufacturer.

12-5 WIRING

RECOIL STARTER OPERATION

Wire as shown in the wiring diagram below. Normally, those indicated by dotted lines are not included in engine wiring. Lighting coil for Models EY15, EY20 and EY28 (an optional, not standard accessory) permits installation of an AC buzzer with an intermediate tap.

[BREAKER POINT IGNITION TYPE]

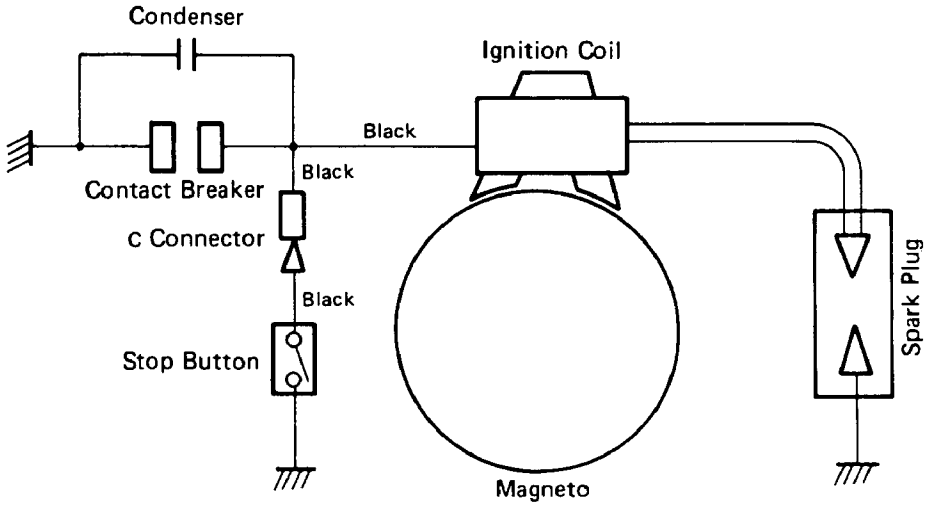


Fig. 61

[SOLID STATE IGNITION TYPE for MODELS EY15 and EY20]

1. T.I.C. (Standard)

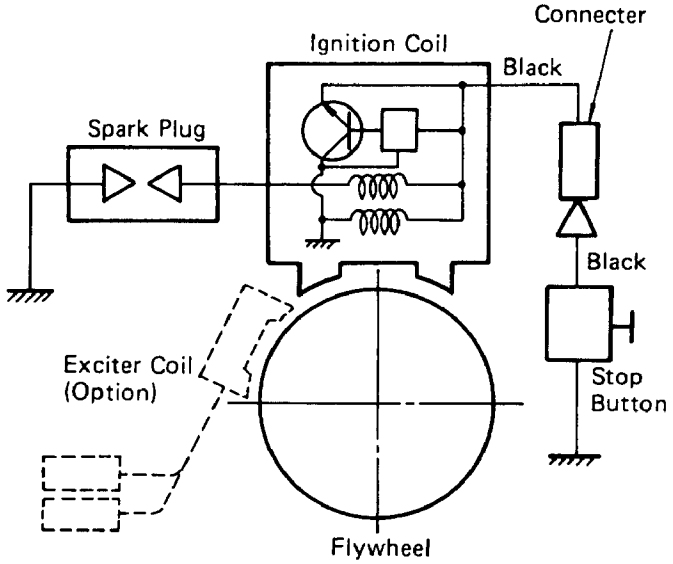


Fig. 62

2. P.I.T. (with lighting coil)

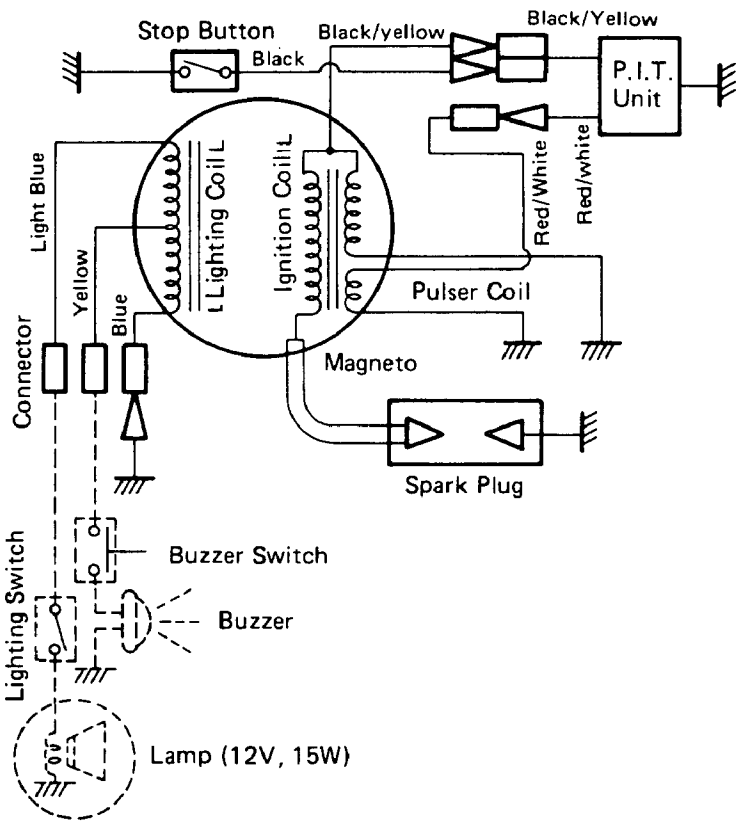


Fig. 63

[SOLID STATE IGNITION TYPE for MODEL EY28]

1. T.I.C. (Standard)

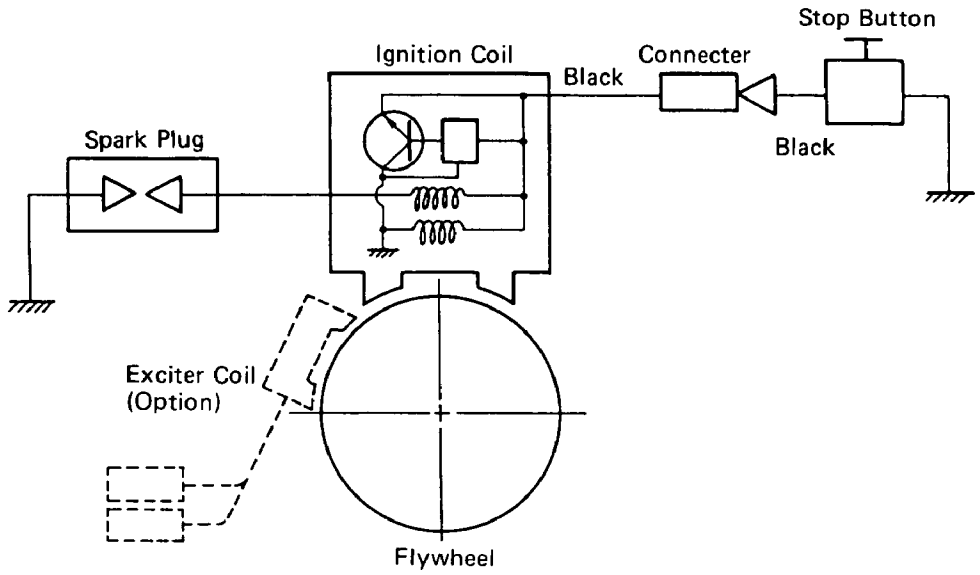


Fig. 64

[ELECTRIC STARTER TYPE for MODEL EY28]

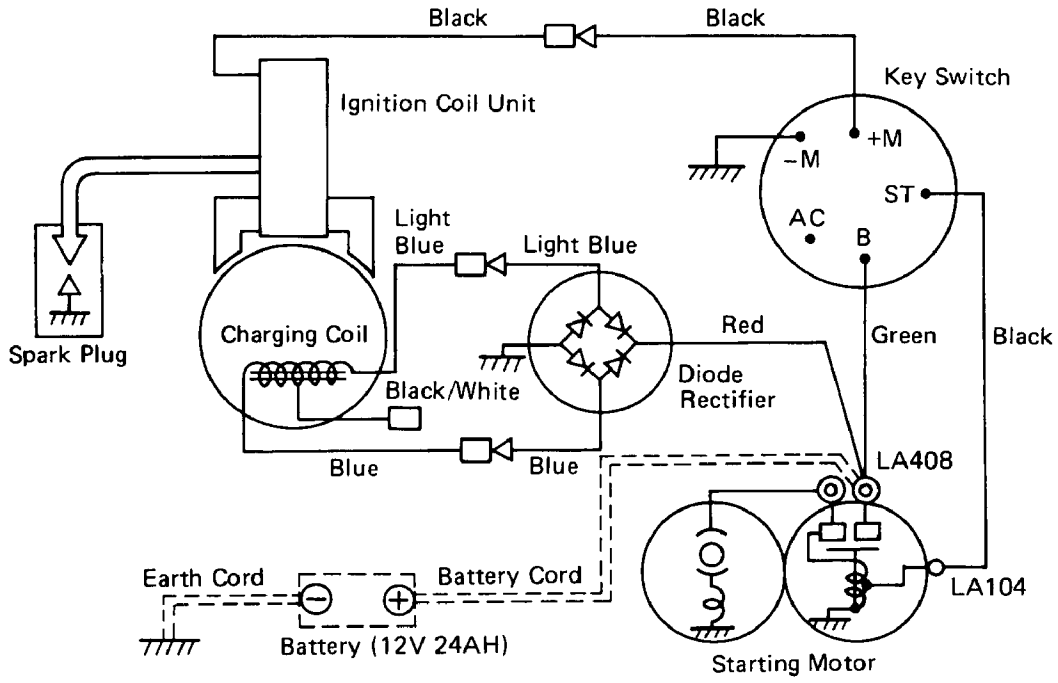


Fig. 65

13. ELECTRIC STARTING MOTOR (OPTION for EY28 ONLY)

13-1 SPECIFICATIONS

Part Name	Starting Motor
Maker	Nihon Denso K. K.
Voltage	12V
Output	0.6 kW
Weight	3.0 kg

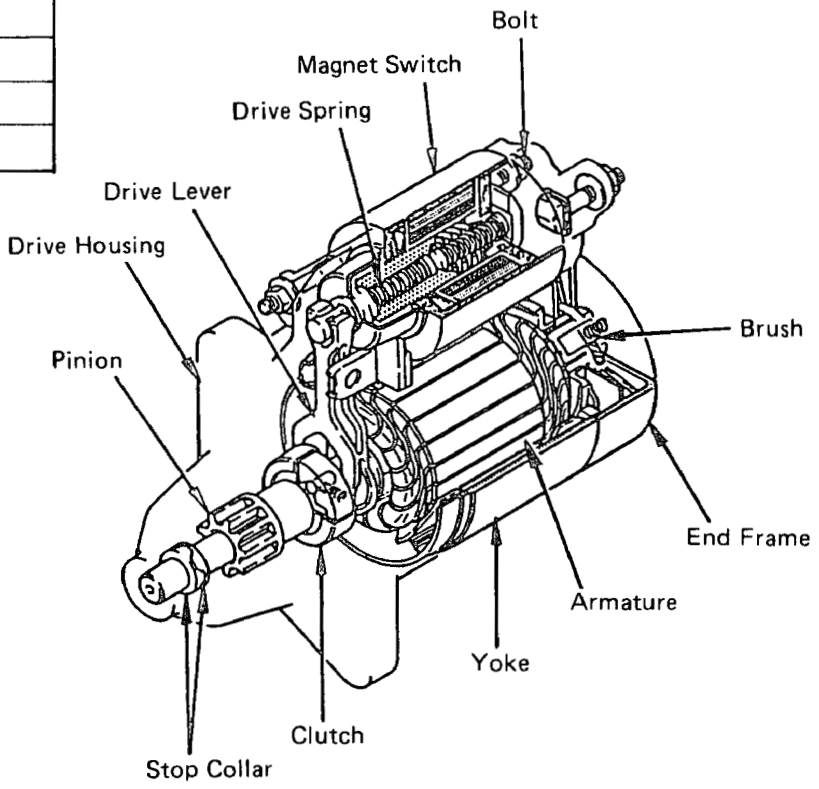


Fig. 66

13-2 OPERATION

Connect the (+) side of battery to the 8ϕ terminal of starting motor magnet switch.

The state of starting motor "ON" is as shown in the following figure:

When the key switch is put to "ON," the M→ circuit is closed and the current flows to the arrowhead direction. The magnet switch coil is excited, and the contact is drawn up.

Then the continuity is made to the starting motor, and the pinion gear is instantaneously pushed out by the drive lever. The pinion gear is engaged with the ring gear, and the engine cranking is made.

This means that the lower current flows in the M→ circuit, and in the S→ circuit larger starter current flows.

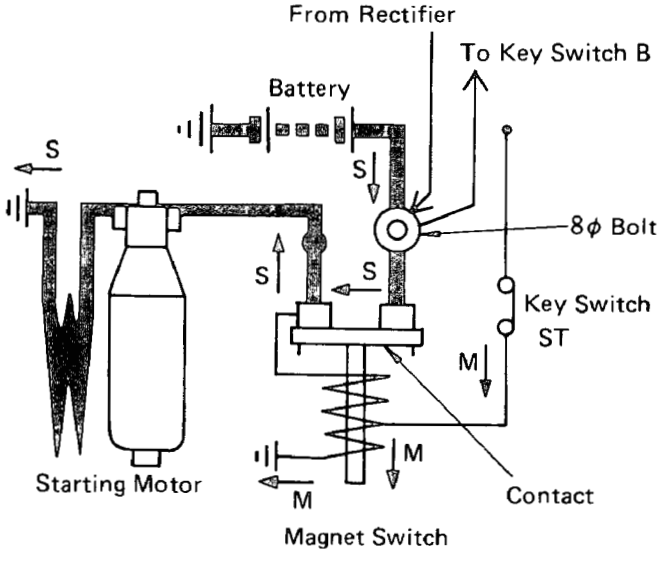


Fig. 67

14. RECOIL STARTER DISASSEMBLY and REASSEMBLY

The recoil starter hardly has a trouble in the normal use, however, in case it has a trouble or at the time of lubrication, perform disassembly and reassembly in the following procedures:

Tools to be used: Box spanner (spanner), Cutting pliers (pliers) and Screw driver

14-1 HOW TO DISASSEMBLE (D Type)

1) Remove the recoil starter from the engine with a box spanner.
2) Pull the starting knob and pull out the starter rope for 30 to 40 cm. Firmly press the reel with a thumb as shown in Fig. 68 so that the reel should not make reverse turn at the place where the reel notch comes to the outlet of starter rope. Pull out the starter rope to the inside of recoil starter with a screwdriver. Then, utilize the reel notch, and rewind it until the rotation stops in the arrowhead direction, braking the reel rotation with a thumb.

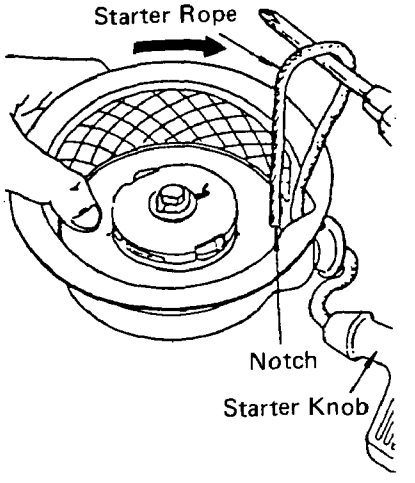


Fig. 68

3) When removing, take out the parts in the order of the numbering in Fig. 69.
    1. U type snap ring
    2. Thrust washer
    3. Friction spring cover
    4. Return spring
    5. Friction spring
    6. Ratchet

    Meantime, for removing the U type snap ring, nip the shaft with cutting pliers and push it out.

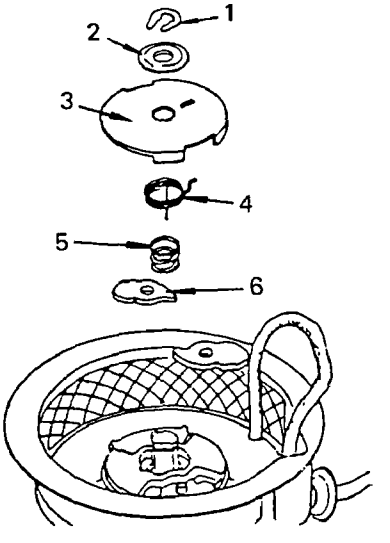


Fig. 69

4) Take out the reel from the starter case as shown in Fig. 70.

In this case, slowly take out it turning the reel lightly toward left and right so that the spring is removed from the reel hook section.

If the reel is suddenly taken out, there is a fear that the spring jumps out in the form as it is hooked, which is very dangerous, so be carefuly of it.

(If the spring jumped out, house it in the starter case as instructed in Fig. 75.)

Finally, release and take out the starter rope tied to both the reel side and the starting knob side.

Thus, the disassembly work ends.

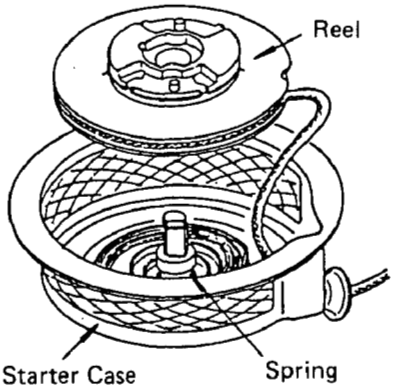


Fig. 70

14-2 HOW TO REASSEMBLE (Type D)

1) First, have the starter rope pass through the starting knob, and tie the rope as shown in Fig. 71 No.1.

Then, have the opposite side of the rope pass through the starter case and the reel, and tie it as shown in Fig. 71 No.2. Then surely house the end in the reel. (In the Fig. 71 both the ropes are tied quite lightly, as you see in figures No.1 and No.2. Please note this is just for the purpose of easy understanding. Therefore, when actually tying, tie the rope as tightely as possible.

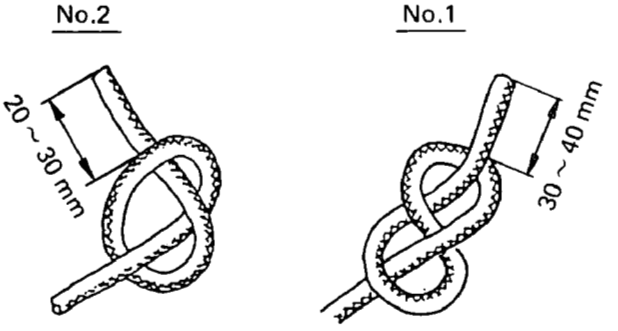


Fig. 71

2) Confirm that the spring is surely set in the starter case housing section, and have the spring to form so that its inner edge will be about 1 mm from the starter shaft and that it hooks surely the reel hook.

Meantime, with the pliers about 10 cm long spring from the inner edge can easily be formed.

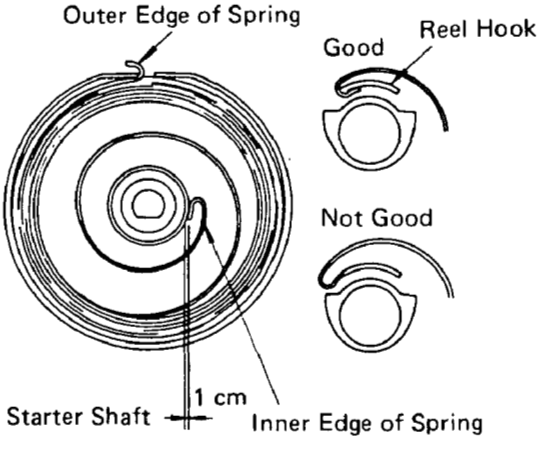


Fig. 72

3) Before putting the reel in the starter case, wind the starter rope in the arrowhead direction as shown in Fig. 73, and at 2.5 windings take out the rope from the reel notch. Set the reel hook to the inner end of the spring, and put the reel in the starter case.
(At this time, confirm that the reel hook is duly set to the spring.)
Then, hold the starter rope as shown in Fig. 73, and turn the reel 4 times in the arrowhead direction. When wound up, firmly press the reel not to allow reverse turn, and pull the starting knob. Then, pull out from the starter case the starter rope utilized for winding, and slowly return the starting knob.

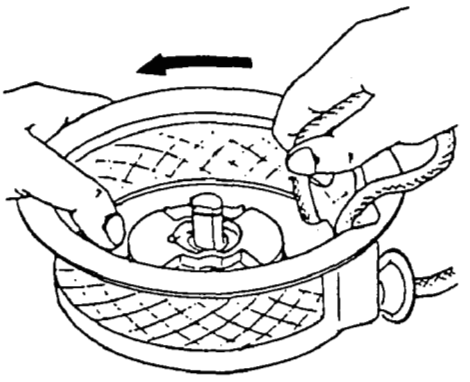


Fig. 73

4) When reassembling the parts, follow up in the reverse order to Fig. 69.
When putting the friction plate in the hole for it, set the return spring a little upward as shown in Fig. 74 so that the friction plate can easily be put in the hole for it.
Next, turn the friction plate in the arrowhead direction till the position where its notch matches with the ratchet. Push firmly the friction plate to the reel side, and put the thrust washer and then clamp it with a U shape snap ring.
(Clamp the U shape snap ring with cutting pliers.)

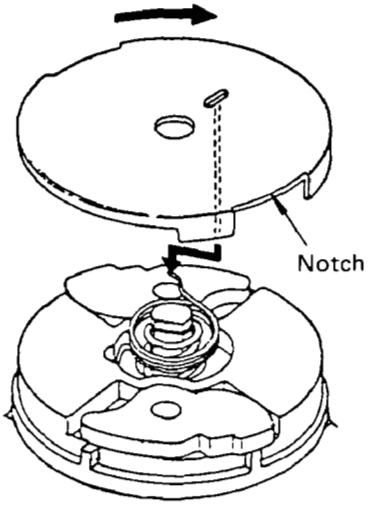


Fig. 74

★ *With the above, the disassembly and reassembly works end, however, there is a case that the parts are not properly reassembled. Therefore, for caution's sake check the function of the recoil starter following the confirmation items described in the next page.*

14-3 CONFIRMATION ITEMS AFTER REASSEMBLY (Type D)

1) Pull the starting knob 2 or 3 times, and pull out the starter rope a little.
   i) If the starting knob is felt heavy to pull and cannot be pulled, check whether the parts were reassembled correctly as instructed.
   ii) If the ratchet does not function, check whether the spring is hooked properly.
2) Pull the starting knob, and pull out the starter rope all the way long.
   i) If the starter rope remains left in the reel or the starter rope does not return at all, immoderate strain is imposed on the spring. So rewind the starter rope 1 or 2 times as per instruction in Fig. 68.
   ii) If the return power of the starter rope is weak or the starting knob is drooped on the way, inject a few drops of mobile oil in the frictional portions. If it does not revive yet, wind it 1 or 2 times. (In this case, refer to the instructions explained in the paragraph i) above and confirm whether or not immoderate strain is imposed on the spring.)
   iii) If the sound is heard that the spring is falling off, and the starter rope cannot be wound in relay, reassemble once again from the biginning.

14-4 HOW TO DO IN SUCH CASES!

1) In case the spring jumps out when disassembling
   With thin wire make a ring smaller than the case for spring, and hook the outer edge of spring on the part of the ring as shown in Fig. 75. House it in the spring housing section of the reel, and calmly remove the ring, pressing the spring with fingers so as not to come out.
   The ring can easily be removed by gouging it with the tip of the screwdriver or the like.
   Meantime, refer to Fig. 72 for not to mistake the housing direction of the spring.
2) In case of lubricating
   Lubricate the rotating parts, frictional parts and spring with heat resistant grease, if possible, or mobile oil at the time of disassembly or at the end of season for use.
3) In case the direction of rotation is reverse (Type B)

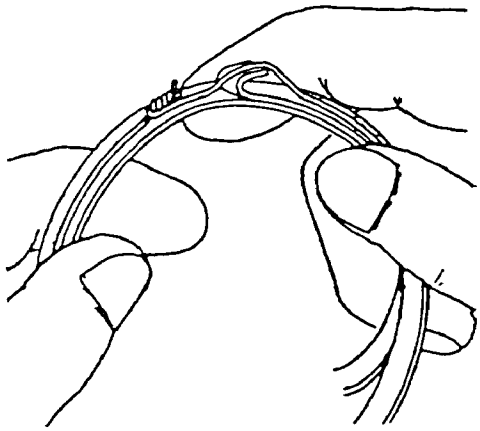


Fig. 75

As this manual is for right rotation recoil starter, perform reverse work for left rotation recoil starter.

15. CHECKS and CORRECTIONS

After disassembling and cleaning the engine, check and repair, if necessary, according to the correction table. The correction table applies whenever the engines are repaired. It is important for the servicemen to be familiar with the contents of this table. Correct maintenance is recommended by observing the correction standards specified.

The meanings of the terms used in the correction table are as follows:

1) Correction

   Repair, adjustment or replacement of any engine parts.

2) Correction Limit

   The limit on wear, damage or functional deterioration of engine parts beyond which normal engine performance cannot be expected without repairing such parts.

3) Use Limit

   The limit beyond which parts can no longer be used in respect of performance or strength.

4) Standard Dimensions

   The design dimensions of new parts minus tolerance.

5) Correction Tolerance

   Tolerance on the dimensions of engine parts refinished or adjusted.

16. TABLES OF CORRECTION STANDARDS

ITEM		ENGINE MODEL	STANDARD SIZE	CORRECTION		USE LIMIT	REMARKS	TOOL	CORRECTION METHOD
				TOLERANCE	LIMIT				
Flatness of cylinder head		EY15 EY20 EY28	Less than 0.1	0.1	0.15			Surface plate, Feeler	Correct
Cylinder	Bore	EY15	S.T.D. 63 dia.	Dif. between max. & min. +0.019 0	0.15	0.65		Cylinder gauge	Boring
		EY20	67 dia.						
		EY28	S.T.D. 75 dia.						
	Roundness	EY15 EY20 EY28		0.01					
	Cylindricity	EY15 EY20 EY28		0.015					
	Valve seat contact width	EY15 EY20 EY28		1.2~1.5	2.5				Correct
	Valve guide I.D.	EY15 EY20 EY28	6.5φ	+0.022 0	0.15	0.15	At middle portion	Cylinder gauge	Replace
Piston	O.D. at skirt, in thrust direction (incl. over size) B 0.25 C 0.5	EY15	S.T.D. 62.98 dia. B 63.23 dia. C 63.48 dia.	0 -0.02	-0.1	-0.1		Micro-meter	Replace
		EY20	S.T.D. 66.98 dia. B 67.23 dia. C 67.48 dia.						
		EY28	S.T.D. 74.98 dia. B 75.23 dia. C 75.48 dia.						
	Width of ring groove	EY15 EY20	Top, 2nd 2	+0.025 0	0.15	0.15		Vernier calipers	Replace
		EY15 EY20	Oil 2.8	+0.035 0					
		EY28	Top 1.5	+0.060 +0.040					
			2nd 1.5	+0.040 +0.020					
			Oil 30	+0.002 -0.009					
	Piston pin hole	EY15 EY20	14 dia.	+0.002 -0.009	0.035	0.035		Cylinder gauge	
		EY28	16 dia.						
	Clearance between piston and cylinder	EY15 EY20		0.020~0.059	0.025	0.25	Max. cylinder dia. and piston dia. at skert in thrust direction	Cylinder gauge, Micro-meter	Replace
		EY28		0.040~0.079					
	Clearance between pisition ring and ring groove	EY15	Top 2nd Oil	0.090~0.135 0.060~0.105 0.010~0.065	0.15	0.15		Feeler gauge	Replace
		EY20	Top 2nd Oil	0.050~0.095 0.010~0.055 0.010~0.065					

ITEM		ENGINE MODEL	STANDARD SIZE	CORRECTION		USE LIMIT	REMARKS	TOOL	CORRECTION METHOD
				TOLERANCE	LIMIT				
Piston	Clearance between pisition ring and ring groove	EY28	Top 2nd Oil	0.050~0.090 0.010~0.065 0.010~0.065	0.15	0.15		Feeler gauge	Replace
Piston Ring	Fit between piston and piston pin	EY15 EY20 EY28		-0.009~0.010	0.06L	0.06L		Cylinder gauge, Micro-meter	
	Ring gap	EY15	Top 2nd Oil	0.20 ~ 0.40	1.5	1.5		Feeler gauge	Replace
		EY20	Top 2nd Oil	0.05 ~ 0.25					
		EY28	Top 2nd Oil	0.1 ~ 0.3					
	Ring width	EY15	Top 2.0 2nd 2.0 Oil 2.8	-0.090~-0.110 -0.060~-0.080 -0.010~-0.030	-0.1	-0.1		Mircro-meter	Replace
		EY20	Top 2.0 2nd 2.0 Oil 2.8	-0.050~-0.070 -0.010~-0.030 -0.010~-0.030					
		EY28	Top 1.5 2nd 1.5 Oil 3.0	-0.010~ 0.030					
Piston pin O.D.		EY15 EY20	14 dia.	0 ~ -0.008	-0.04	-0.04		Micro-meter	Replace
		EY28	16 dia.						
Connecting Rod	Large end I.D.	EY15	24 dia.	+0.013 0	0.1	0.1		Cylinder gauge	Replace
		EY20	26 dia.						
		EY28	28 dia.						
	Clearance between rod large end I.D. and crankpin	EY15 EY20		0.037~0.063	0.2	0.2		Cylinder gauge, Micro-meter	Replace
		EY28		0.020~0.046					
	Small end I.D.	EY15 EY20	14 dia.	0.010~0.021	0.08	0.08		Cylinder gauge	Replace
		EY28	16 dia.						
	Clearance between small end I.D. and pinston pin	EY15 EY20 EY28		0.010~0.029	0.12	0.12		Cylinder gauge, Micro-meter	Replace
	Large end side clearance	EY15 EY20 EY28		0.1 ~ 0.3	1.0	1.0		Feeler gauge	Re-machine or Replace
	Parallelism between large end and small end bores	EY15 EY20 EY28		0.05	0.1	0.1		Test bar and Dial gauge	Re-machine or Replace
	Distance between large end and small end bores	EY15	83	±0.1		0.15			
		EY20	91						
		EY28	100						

	ITEM	ENGINE MODEL	STANDARD SIZE	CORRECTION		USE LIMIT	REMARKS	TOOL	CORRECTION METHOD
				TOLERANCE	LIMIT				
Crankshaft	Crankpin O.D.	EY15	24 dia.	-0.037 -0.050	0.15	0.5		Micro-meter	Re-machine or Replace
		EY20	26 dia.						
		EY28	28 dia.	-0.020 -0.033					
	Crankpin O.D. roundness	EY15 EY20 EY28		Less than 0.005				Micro-meter	
	Crankpin O.D. cylindricity	EY15 EY20 EY28		Less than 0.005				Micro-meter	
	Crankpin O.D. parallelism	EY15 EY20 EY28		Less than 0.008				Dial gauge	
	Crankshaft journal O.D.	EY15	Drive s. 25 dia.	-0.003 -0.012	-0.05	-0.05		Micro-meter	Replace
			Mag. s. 25 dia.						
		EY20	Drive s. 25 dia.						
			Mag. s. 25 dia.						
		EY28	Drive s. 30 dia.						
			Mag. s. 30 dia.						
Camshaft	Cam lobe height	EY15	24.95	±0.1	-0.25	-0.25		Micro-meter	Replace
		EY20	28.8						
		EY28	30.8						
	Journal O.D.	EY15 EY20	Drive s. 15 dia.	-0.016~-0.027	-0.05	-0.05		Micro-meter	Replace
			Mag. s. 15 dia.						
		EY15B	Drive s. 25 dia.	-0.003~-0.012					
			Mag. s. 15 dia.	-0.016~-0.027					
		EY28D	Drive s. 15 dia.	-0.016~-0.027					
			Mag. s. 25 dia.	-0.020~-0.033					
		EY28B	Drive s. 30 dia.	-0.003~-0.012					
			Mag. s. 25 dia.	-0.020~-0.033					
Valve spring	Free length	EY15 EY20 EY28	37		-1.5			Vernier calipers	Replace
	Squareness	EY15 EY20 EY28				1.0	For total length	Square	Replace

	ITEM	ENGINE MODEL	STANDARD SIZE	CORRECTION		USE LIMIT	REMARKS	TOOL	CORRECTION METHOD
				TOLERANCE	LIMIT				
Intake & Exhaust Valves	Valve stem O.D.	EY15 EY20 EY28	Intake 6.5 dia. Exhaust	-0.025~-0.040 -0.056~-0.078	-0.15			Micro-meter	Replace
	Clearance between stem and guide	EY15	Intake Exhaust	0.025 ~ 0.062 0.056 ~ 0.100	0.3	0.3	At middle	Cylinder gauge	Replace
		EY20 EY28	Intake Exhaust	0.025 ~ 0.062 0.056 ~ 0.100					
	Tappet clearance	EY15 EY20 EY28		When cold 0.10 ±0.02	below 0.05 above 0.25			Feeler gauge	Correct
	Clearance between groove and retainer	EY15 EY20 EY28		0.1 ~ 0.3	0.5	0.5		Feeler gauge	Replace
	Stem end length	EY15	Intake 5.9 Exhaust 5.9		-1.0	-1.0		Vernier calipers	Replace
		EY20	Intake 6.2 Exhaust 6.4						
		EY28	Tntake Exhaust 4.45						
Tappet	Total length	EY15	35.6	+0.06 ~ 0	-0.5	-0.5		Vernier calipers	Replace
		EY20	41.7						
		EY28	43.7						
	Clearance between stem and guide	EY15 EY20		0.013 ~ 0.037	0.2	0.2			
		EY28		0.013~0.043					
Electric Device	Spark plug	EY15 EY20	NGK B-6HS						
		EY28	NGK BP-6HS						
	Spark gap	EY15 EY20 EY28		0.6 ~ 0.7	1			Feeler gauge	Adjust or replace
	Spark timing	EY15 EY20 EY28	23° before T.D.C.	± 2°	± 5°			Timing tester	Adjust
	Point opening	EY15 EY20	0.35	± 0.05	± 0.1			Contact breaker spanner	Adjust

ITEM	MODEL	HP/rpm	CORRECTION LIMIT	REMARKS
Max. Output	EY15D EY15B EY20D EY28D EY28B	3.5/4000 3.5/2000 5.0/4000 7.5/4000 7.5/2000	Below 110% of rated output	
Continuous Rated Output	EY15D EY15B EY20D EY28D EY28B	2.7/3600 2.7/1800 3.5/3600 5.5/3600 5.5/1800		

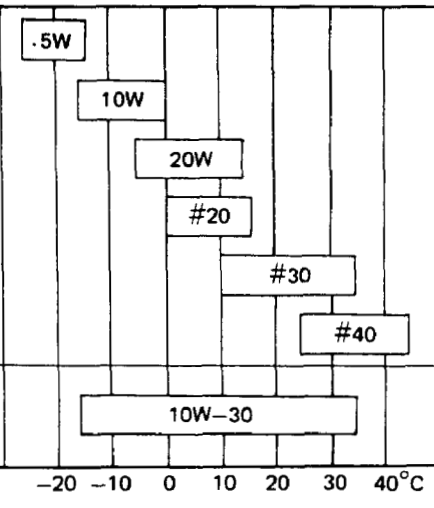
ITEM	MODEL	liter/hr	CORRECTION PRECISENESS	CORRECTION PROCEDURE
Fuel Consumption	EY15 EY20 EY28	1.1 1.2 2.7	135% of the standard value and up	3600 rpm at continuous rated output

ITEM	MODEL	cc/hr	USE LIMIT cc/hr	REMARKS
Lubricant Consumption	EY15	10	50	
	EY20 EY28	15	60	

ITEM	MODEL	ℓ	REMARKS
Fixed quantity of Lubricant	EY15 EY20	0.6	
	EY28	0.85	

☆Use the SC or higher grade engine oil.

ITEM	MODEL	Comparison between oil viscosity and temparature	REMARKS
Specified Lubricant Quality	EY15 EY20 EY28	Single grade	When the peripheral temparature is below −20°C, use the oil of viscosity and quality fitted to the local conditions.
			When the peripheral temparature is more than 40°C, use the oil of viscosity and quality fitted to the local conditions.
		Multi-grade	The oil consumption is apt to increase, when used under high peripheral temparature, so it is necessary to check every day.



• If quality and quantity of the engine oil become lower or less, burning might be caused.

ITEM	MODEL	FREQUENCY OF OIL CHANGE
Oil Change	EY15 EY20 EY28	First time: Change oil after 20 hours operation. Second Time and Thereafter: Change oil every 50 hours operation.

ITEM	MODEL	kg/cm²/rpm	CORRECTION LIMIT	TOOL	REMARKS
Cylinder pressure	EY15	5/400	70% of normal value and down	Pressure gauge	Reference value Crankshaft Rev.
	EY20 EY28	6/400			

ITEM	MODEL	rpm	TOOL	REMARKS
Min. accelerating revolution	EY15D	1200	Tachometer	
	EY15B	600		
	EY20D	1200		
	EY28D	1200		
	EY28B	600		

	ITEM	MODEL	kg-cm	ft-lb	TOOL	REMARKS
Tightening Torque	Cylinder head bolts	EY15 EY20	190 ~ 230			Torque wrench
		EY28	220 ~ 260			
	Connecting rod bolts	EY15	90 ~ 115			Torque wrench
		EY20 EY28	170 ~ 200			
	Magneto clamp nuts	EY15 EY20 EY28	600 ~ 650			Torque wrench
	Main bearing cover bolts	EY15 EY20	80 ~ 100			Torque wrench
		EY28	170 ~ 190			
	Spark plug	EY15 EY20	120 ~ 150			Torque wrench
		EY28	230 ~ 270			

17. MAINTENANCE and STORING

The following maintenance jobs apply when the engine is operated correctly under normal conditions. The indicated maintenance intervals are by no means guarantees for maintenance free operations during these intervals.
For example, if the engine is operated in extremely dusty conditions, the air cleaner should be cleaned every day instead of every 50 hours.

17-1 DAILY CHECKS and MAINTENANCE

Checks and maintenance	Reasons for requiring them
Remove dust from whatever parts which accumulated dust.	The governor linkage is especially susceptible to dust.
Check external fuel leakage. If any, retighten or replace.	Not only wasteful but also dangerous
Check screw tightening. If any loose one is found, re-tighten.	Loose screws and nuts will result in vibration accidents.
Check oil level in crankcase and add up as necessary.	If the engine is operated without sufficient oil, it will fail.

17-2 EVERY 20 HOURS CHECKS and MAINTENANCE

Checks and maintenance	Reasons for requiring them
Change crankcase oil.	To remove run-in wear particles

17-3 EVERY 50 HOURS (10 DAYS) CHECK and MAINTENANCE

Checks and maintenance	Reasons for requiring them
Change crankcase oil.	Contaminated oil accelerates wear.
Clean air cleaner.	Clogged air cleaner harms engine operation.
Check spark plug. If contaminated, wash in gasoline or polish with emery paper.	Output power is reduced and starting is made difficult.

17-4 EVERY 100 ~ 200 HOURS (MONTHLY) CHECKS and MAINTENANCE

Checks and maintenance	Reasons for requiring them
Clean fuel filter and fuel tank.	The engine will be out of order.
Clean contact breaker points.	The engine output drops.

17-5 EVERY 500 ~ 600 HOURS (SEMIANNUAL) CHECKS and MAINTENANCE

Checks and maintenance	Reasons for requiring them
Remove cylinder head and remove carbon deposit.	The engine will be out of order.
Disassemble and clean carburetor.	

17-6 EVERY 1000 HOURS (YEARLY) CHECKS and MAINTENANCE

Checks and maintenance	Reasons for requiring them
Perform overhauls, clean, correct or replace parts.	The engine output drops and become out of order.
Change piston rings.	
Replace fuel pipe once a year.	To prevent from danger caused by the fuel leakage.

17-7 PREPARATION for LONG ABEYANCE

1) Perform the above 17-1 and 17-2 maintenance jobs.
2) Drain fuel from the fuel tank and carburetor float chamber.
3) To prevent rust in the cylinder bore, apply oil through the spark plug hole and turn the crankshaft several turns by hand. Reinstall the plug.
4) Turn the starting pulley by hand and leave it where the resistance is the heaviest.
5) Clean the engine outside with oiled cloth.
6) Put a vinyl or other cover over the engine and store the engine in dry place.

Industrial Engines

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